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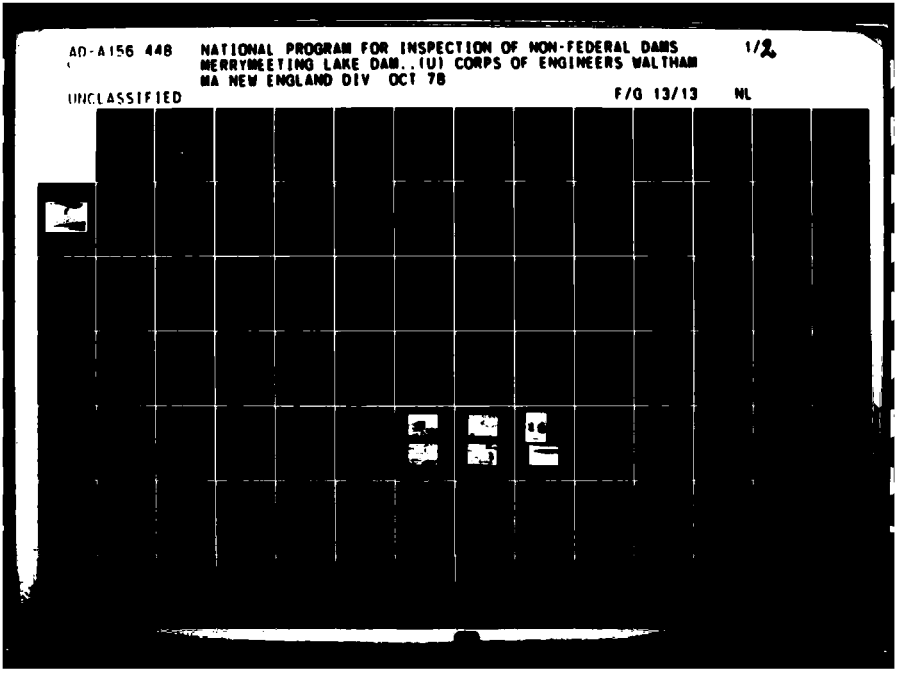

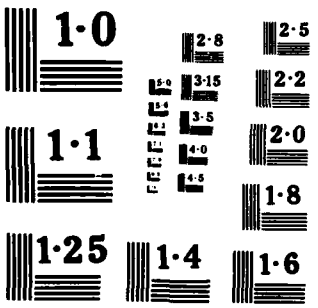
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MERRIMACK RIVER BASIN
NEW DURHAM, NEW HAMPSHIRE

MERRYMEETING LAKE DAM
NH 00342

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS, 02154

OCTOBER 1978

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

DAMS, INSPECTION, DAM SAFETY,

Merrimack River Basin
New Durham, New Hampshire
Merrymeeting River

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

TLe dam is an earth embankment structure. THe dam is 286 ft. long and 22 ft. high. The condition of the dam is fair in spite of a continued history of seepage through the dam that has not been eliminated by refacing the upstream side of the dam. The estimated PMF would overtop the dam by 6.6 ft.

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REPLY TO
ATTENTION OF
NEDED-E

MAY 23 1979

Honorable Hugh J. Gallen
Governor of the State of New Hampshire
State House
Concord, New Hampshire 03301

Dear Governor Gallen:

I am forwarding for your use a copy of the Merrymeeting Lake Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. The report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis. A brief assessment which emphasizes the inadequacy of the project spillway under test flood conditions is included at the beginning of the report.

The preliminary hydrologic analysis has indicated that the spillway capacity for the Merrymeeting Lake Dam would likely be exceeded by floods greater than 20 percent of the Probable Maximum Flood (PMF), the test flood for spillway adequacy. Screening criteria for initial review of spillway adequacy specifies that this class of dam, having insufficient spillway capacity to discharge fifty (50) percent of the PMF, should be adjudged as having a seriously inadequate spillway and the dam assessed as unsafe, non-emergency, until more detailed studies prove otherwise or corrective measures are completed.

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations there appears to be a serious deficiency in spillway capacity. This could render the dam unsafe in the event of a severe storm which would likely cause overtopping and possible failure of the dam, significantly increasing the hazard potential for loss of life downstream from the dam.

NEDED-E
Honorable Hugh J. Gallen

It is recommended that within twelve months from the date of this report the owner of the dam engage the services of a professional or consulting engineer to determine by more sophisticated methods and procedures the magnitude of the spillway deficiency. Based on this determination, appropriate remedial mitigating measures should be designed and completed within 24 months of this date of notification. In the interim a detailed emergency operation plan and warning system should be promptly developed. During periods of unusually heavy preciptiation, round-the-clock surveillance should be provided.

I have approved the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of the non-Federal Dam Inspection Program.

A copy of this report has been forwarded to Water Resources Board, the cooperating agency for the State of New Hampshire. This report has also been furnished to the owner of the project, State of New Hampshire, Fish and Game Department, Concord, New Hampshire 03301.

Copies of this report will be made available to the public, upon request to this office, under the Freedom of Information Act, thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Water Resources Board for the cooperation extended in carrying out this program.

Sincerely yours,

JOHN P. CHANDLER
Colonel, Corps of Engineers
Division Engineer

MERRYMEETING LAKE DAM

NH 00342

MERRIMACK RIVER BASIN
NEW DURHAM, NEW HAMPSHIRE

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Merrymeeting Lake Dam, I.D. NH 00342
State Located:	New Hampshire
County Located:	Strafford
Town Located:	Rumney
Stream:	Merrymeeting River
Date of Inspection:	June 6 and 7, 1978

BRIEF ASSESSMENT

Merrymeeting Lake Dam is an earth embankment structure built on top of an existing older stone cut masonry dam. The dam is 286-foot long and 22-foot high. The spillway is located on natural ground in the right abutment and consist of a 20-foot long concrete crest transitioning into a 10-foot wide spillway chute channel.

The physical condition of the dam is fair in spite of a continued history of seepage through the dam that has not been eliminated by refacing the upstream side of the dam.

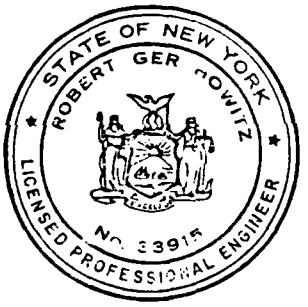
Merrymeeting Lake has a large water surface area with respect to drainage area and a very limited spillway capacity. One inch of runoff is equivalent to 1/2 foot rise in the lake; therefore, the 2-foot minimum surcharge represents about 4 inches of runoff or about 20 percent of the Probable Maximum Flood Runoff (PMF), the recommended test flood for this project. The estimated PMF would overtop the dam by 6.6 feet. Further studies are needed to establish the need for increased spillway capacity or increased height of dam to permit greater surcharge storage, or a combination of the two.

It is recommended that the owner, within 12 months after receipt of this Phase I Report, acquire basic engineering data that would allow the proper assessment of the seriousness of the observed seepage and its effect on the stability of embankment's toe slope.

Other recommended maintenance actions relate to the selective clearing of trees along the spillway discharge channel and low level outlet channel, and the improvement and protection of the spillway outlet channel.

Robert Gershowitz, PE

Robert Gershowitz, P.E.



This Phase I Inspection Report on Merrymeeting Lake Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

Charles G. Tiersch

CHARLES G. TIERSCH, Chairman
Chief, Foundation and Materials Branch
Engineering Division

Fred J. Ravens Jr.

FRED J. RAVENS, Jr., Member
Chief, Design Branch
Engineering Division

Saul Cooper

SAUL COOPER, Member
Chief, Water Control Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe condition be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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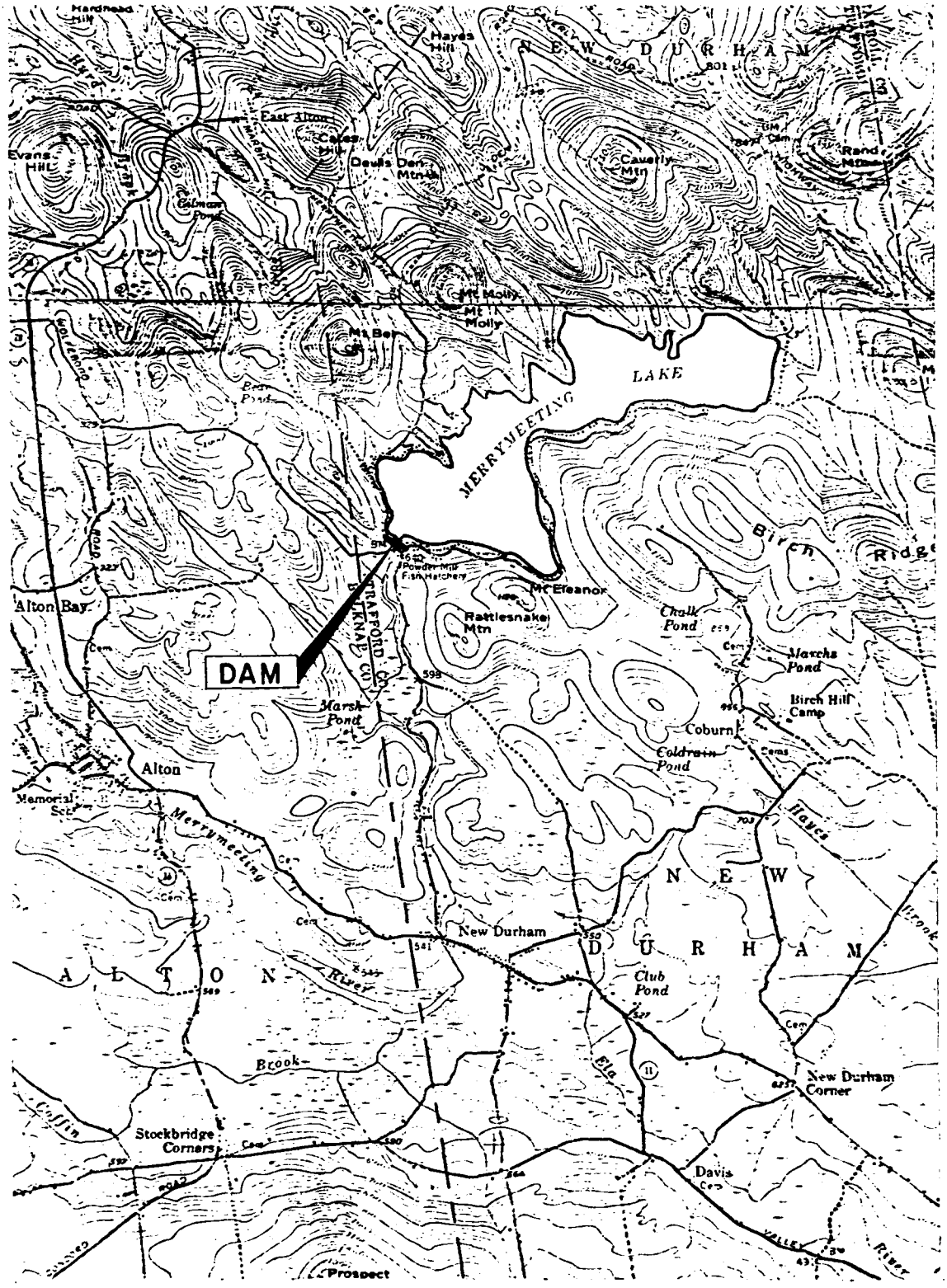
View of the dam from the downstream side. The low level outlet gate house is in the center. The zone of seepage is demarcated by the end of the cut grass area and the swamp-type vegetation below it.



VICINITY MAP

Quadrangle: Alton , N.H.
Scale: 1:62,500

PHASE I INSPECTION REPORT
MERRYMEETING LAKE DAM NH 00342

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. HARRIS-ECI ASSOCIATES has been retained by the New England Division to inspect and report on selected dams in the State of New Hampshire. Authorization and notice to proceed was issued to HARRIS-ECI ASSOCIATES under a letter of June 7, 1978 from Ralph T. Garver, Colonel, Corps of Engineers. Contract No. DACW 33-78-C-0305 has been assigned by the Corps of Engineers for this work.

b. Purpose

(1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-federal interests.

(2) Encourage and assist the States to initiate quickly effective dam safety programs for non-federal dams.

(3) To update, verify and complete the National Inventory of Dams.

1.2 Project Description

a. Location

Merrymeeting Lake Dam is located on the Merrymeeting River in the Town of New Durham, Strafford County, New Hampshire, approximately 3.5 miles north and upstream of the hamlet of New Durham. The Merrymeeting River is a tributary of Lake Winnipesaukee, and part of the Merrimack River Basin.

b. Description of Dam and Appurtenances

Merrymeeting Lake Dam is an earth embankment structure built on top of an existing older cut stone masonry dam. The dam is 286 ft. long, 22 ft. high, and impounds 19,500 acre feet of water derived from an 11 square mile watershed. The upstream face of the dam is a vertical concrete wall built on top and in front of the older masonry structure, acting as the impervious barrier. The embankment has a top width of approximately 12 feet and the grass covered downstream face of the embankment slopes at 1 on 3 horizontal. The spillway is located on natural ground in the right abutment. The spillway crest is 20-foot long, feeding into a chute section approximately 55-foot long and 10-foot wide. The dam's low level outlet consist of a 48-inch diameter line controlled by a sluice gate in a recess on the upstream face of the dam. The impounded lake supplies water to the Powder Mill Fish Rearing Facility through a nearby intake, independent of the dam.

The Merrymeeting Lake is a natural lake covering over 1,200 acres at normal pool levels. Its maximum depth is in excess of 110 ft. at places. The rim of the lake is sparsely developed and is wooded for the most part. The rim is moderately sloping and no signs of instability are readily apparent.

The downstream channel of the Merrymeeting River is very shallow and narrow with wooded overbanks. A roadway leading to the hamlet of New Durham crosses the river channel some 250 ft. downstream of the dam axis and could control the tailwater levels at the dam at high discharges.

c. Size Classification

According to the "Recommended Guidelines of the Safety Inspection" by U.S. Department of the Army, Office of the Chief of Engineers, the dam is classified in the dam size category as being "Intermediate" since its storage is more than 1,000 acre-feet, but less than 50,000 acre-feet. The dam is also classified as "Small" because its height is less than 40 feet. The overall size classification is determined by the larger of these two classifications, and accordingly Merrymeeting Lake Dam is classified as "Intermediate" in size.

d. Hazard Classification

The dam has been classified as having a High Hazard Potential in the Inventory of Dams compiled by U.S. Army Corps of Engineers on the basis that excessive damage could occur to downstream property in the event of failure of the dam and its appurtenances, together with the possibility of losing more than a few lives. This inspection concurs with the assessment on the basis that the dam impounds a very large volume of water, and that, in case of hypothetical dam failure, the foundation would be susceptible to further erosion and increasing flood discharge volumes. The nearest population center, New Durham, some 3.5 miles downstream along the river would in case of such a hypothetical failure have only approximately 15 minutes warning to implement flood disaster procedures.

e. Ownership

Merrymeeting Lake Dam is owned by the State of New Hampshire, Fish and Game Department.

f. Operator

Merrymeeting Lake Dam is operated by the staff of the Powder Mill Fish Rearing Station in New Durham, New Hampshire.

g. Purpose of Dam

The dam is operated by New Hampshire's Fish and Game Department in conjunction with its Powder Mill Fish Rearing Station on the banks of the river immediately downstream of the dam axis. The lake serves as a recreation resource for fishing and other water related activities.

h. Design and Construction History

Although Merrymeeting Lake is natural, the lake level has been raised and controlled by some sort of an impounding barrier at its natural outlet for a long time. The original lake level was apparently at elevation 631.50 and was raised to elevation 641.50 by the preceding structure, and finally to elevation 648 $\pm$ by the present dam, which was completed in 1923. The present dam incorporated the previous dressed stone masonry and gravel fill structure by utilizing it as a base and support for an upstream concrete facing wall which serves as the main impervious barrier. The embankment itself consists of compacted pervious materials. The dam was designed by the I.W. Jones Company, Engineers and Designers of Water Power Plants of Milton, New Hampshire. It produced electric power for the rural area around the dam until after World War II, when power production was abandoned and the dam was acquired by the Fish and Game Department.

i. Normal Operating Procedures

At present, the lake is used to supply 4,500 gpm (10 cfs) of water to the Powder Mill Fish Rearing Station by way of a 14-in. diameter pipeline having an independent lake intake from the dam facility. In the summer months, the pool level is maintained at elevation 648.50 by

means of stop planks placed across the spillway crest until September 24th, when the lake is gradually lowered, reaching elevation 646.50 around November 1st. In the winter months, the lake level is further lowered to elevation 645.5 at the beginning of the snowmelt season. The level of the lake is permitted to rise to its summer time levels by the beginning of June.

The Fish and Game Department has solicited and obtained operating advice from the N.H. Water Resource Board on the regulation of the outlet facilities of dam in order to reach the above-mentioned summer lake levels. Springtime lake releases are heavily dependent on the depth of snow cover within the watershed and its estimated water content.

1.3 Pertinent Data

a. Drainage Area — 11.0 square miles

b. Discharge at Dam Site

Maximum known flood at dam site:	Less than 200 cfs (estimated)
Warm water outlet at pool elevations:	NA
Diversion tunnel low pool outlet at pool elevation:	NA
Diversion tunnel outlet at pool elevation:	NA
Gated spillway capacity at pool elevation:	NA
Gated spillway capacity at maximum pool elevation:	NA
Ungated spillway capacity at maximum pool elevation:	190 cfs at lake elevation 650.5, assuming flash boards are in place
Total spillway capacity at maximum pool elevation:	190 cfs at lake elevation 650.5, assuming flash boards are in place

c. Elevation (Feet above MSL)

Top of dam:	650.5
Maximum pool design surcharge:	650.5
Full flood control pool:	NA
Recreation pool:	648.5 (flash board in place)
Spillway crest:	647.5 permanent concrete crest
Upstream portal invert diversion tunnel:	NA
Downstream at centerline diversion tunnel:	NA
Streambed at centerline of dam:	625.5
Maximum tailwater:	Unknown

d. Reservoir

Length of maximum pool:	3.80 miles (estimated)
Length of recreation pool:	3.50 miles (estimated)
Length of flood control pool:	NA

e. Storage (acre-feet)

Recreation pool:	19,500 AF (lake elev. 648.5 flash boards in place)
Flood control pool:	NA
Design surcharge:	21,960 AF, Elev. 650.5
Top of dam:	21,960 AF, Elev. 650.5

f. Reservoir Surface (acres)

Top of dam:	1,244 (Elev. 650.5)
Maximum pool:	1,244 (Elev. 650.5)
Flood control pool:	NA
Recreation pool:	1,217 A (El. 648.5) flashboards in place
Spillway crest:	1,217 A (El. 648.5) flashboards in place

g. Dam

Type:	Concrete and masonry structure with earth fill embankment on downstream side
Length:	286 feet
Height:	22 feet
Top width:	Approximately 12 feet
Side Slopes - Upstream:	Vertical
- Downstream:	1 on 3 horizontal
Zoning:	None
Impervious core:	Upstream concrete facing
Cutoff:	Unknown
Grout curtain:	None

h. Diversion and Regulating Tunnel

Type:	NA
Length:	NA
Closure:	NA
Access:	NA
Regulating facilities:	NA

i. Spillway

Type:	Chute spillway on right abutment
Length of weir:	20 feet
Crest elevation:	647.5
Gates:	None
U.S. Channel:	None, reservoir
D/S Channel:	Chute, 10-ft wide, approx. 55-ft long

j. Regulating Outlets

Low level outlet:	48-in. pipe through dam
Controls:	48-in. timber sluice gate, mounted on upstream face of dam
Emergency gate:	None
Outlet:	Merrymeeting River

SECTION 2

ENGINEERING DATA

2.1 Design

Design drawings have been recovered from the files of the New Hampshire Water Resources Board (NH-WRB) for the 1923 reconstruction of the dam (Drawings 2 and 3). These drawings show the plan and elevation of the dam, as well as cross sections through the dam and the spillway. The drawings are not marked "as-built." A plan of the lake as surveyed by the NH-WRB is also available (Drawing 1). Design information on the discharge capacity of the spillway and the 48-inch diameter low level outlet are also in the files of the NH-WRB. No computations relating to the original design were recovered, either in the field of hydrology of hydraulics or in the area of dam stability. No information on foundation conditions or embankment fill material is available for safety assessment. No data on the refacing of the dam in 1969 was recovered.

2.2 Construction

A weekly report of construction activities as written by the superintendent for the Ames Construction Company is in the files of the NH-WRB. These reports start on October 22, 1922, and end on August 30, 1923 when the work was considered finished. No work was performed in February and March of 1923. The cutoff for the concrete facing wall was trenched into blue clay upstream of the existing dam structure. In general, not much technical information can be extracted from the construction reports that is of interest to the design engineer. The reports are nevertheless of interest in assembling documentation for the construction of the dam.

2.3 Operation

A number of documents relating to the operation of Merrymeeting Lake were recovered from the files of the NH-WRB. These documents relate to the regulation of spring time releases of water out of the low level outlet in order to achieve normal lake levels (Elevation 648.0±) by June. The N.H. Fish and Game Department, asked for and received advice from the NH-WRB on the proper regulation of water releases in order to achieve the targeted lake levels. Releases in the spring period are heavily dependent on the snow cover within the watershed and the water content of the snow. The NH-WRB also computed low level outlet discharge capacities at various lake levels and partial gate openings and supplied an operating graph for convenient estimation of discharges. Active lake storage volumes are recorded by the N.H. Fish and Game Department at the end of every month and these figures are forwarded to the U.S.G.S. for publication in their annual surface water record compilation for New Hampshire.

2.4 Evaluation

a. Availability

The available information gathered is fair. Although plans of the structure are available, no design criteria or computations relating to spillway design floods or dam stability were recovered. No information on the engineering properties of the foundation or embankment are available to assess dam stability.

b. Adequacy

The lack of in-depth engineering data did not allow for a definitive review. Therefore the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Validity

The validity of the plans recovered is considered fair to good when compared with the actual structure on the ground. Questions requiring clarifications are:

(1) Was the sheet pile cutoff under the concrete cutoff wall actually installed?

(2) Were the cobble stone drains actually installed as shown in the embankment?

Other points of difference between available drawings and the actual structure are:

(1) The spillway chute walls are apparently some 20 feet shorter than indicated on the drawings.

(2) A new concrete facing has been added to the original concrete cutoff wall. No documentation on the construction of this addition was uncovered anywhere. The construction dates to 1969, according to the dam superintendent.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General

The general appearance and condition of the dam was good to fair in that the facility has been maintained and cared for. The main safety concern is related to the significant amount of leakage daylighting from the downstream face of the embankment slope.

b. Dam

The abutments appeared to be in good condition with no visible signs of erosion or sloughing. Numerous rock outcrops can be seen in the right abutment.

A zone of seepage was observed in the downstream face of the embankment, approximately 11 feet below the top of the embankment and extending from a point about 54 feet to the right of the low level outlet continuously to a point about 36 ft. to the left of the outlet. The seepage was clean at the time of the inspection. While a considerable quantity of water was observed, an accurate estimate of the seepage could not be made due to the extent of the zone. A measurement made in March 1965, however, records the seepage as being 79 gpm, based on a stream gauge at the Powder Mill Fish Hatchery.

The seepage on the dam on the day of inspection is estimated to be less than the 1965 observation. It is not known what effect the resurfacing of the upstream face of the dam has had on seepage volumes observed. The dam has been resurfaced in 1969, after the 1965 seepage volume calculation. A small eroded area, approximately 2 to 3-foot wide, was observed in the seepage area. Probing by hand in this area revealed a coarse gravel below the surface.

From the appearance of the seepage, it is not clear what path the seepage water is taking and what, if any, gaps exist in the upstream concrete wall and its connection to the subgrade. Also unknown at this time is the role the cobble stone drains play in the visible seepage. The zone of seepage is quite evident on the downstream face of the embankment. Above the seepage zone, the embankment is smoothly graded and covered with well-trimmed grass, while below the seepage level the embankment slope is uneven and covered with vegetation typical of swampy or boggy areas. The embankment slope below the seepage zone is soft and locally eroded.

c. Appurtenant Structures

Spillway. The spillway consists of a concrete crest 20-foot long transitioning into a 10-foot wide spillway chute channel. The spillway chute walls are 3-foot high and are built of cobble masonry whose joints are slightly deteriorated. The upper chute floor is rough finished. At the end of the walled chute section, the floor slab continues for another 20 feet. In this section, the grade is a little steeper than in the upper chute, and the walls are discontinued. To contain and control the chute water, the floor slab in this section is dished. The construction joint between the two chute slab sections is eroded and irregular. At the end of lower chute slab, the spillway water drops approximately 2 feet and enters a natural channel with a rocky bottom, which joins the channel of the Merrymeeting River some 200 feet downstream of the dam axis.

The 20-foot spillway crest is broken into two 10-foot sections by an intermediate pier. A wood plank walkway connects the right abutment area with the top of the embankment. The wood plank walkway is inadequately fastened to its supports and could be swept away at high overflow stages.

Parts of the upper spillway walls and intermediate pier apparently have been replaced or resurfaced at some time after the original dam was completed.

Low Level Outlet. Low level outlet facilities consists of a single 4-foot diameter outlet with invert at elevation 628.5. A sluice gate, located on the front face of the dam, controls the flow through the outlet. Although the gate was not visible, the dam operator stated that it was of timber construction equipped with a steel stem. The sluice gate is provided with a manually operated floor stand manufactured by Rodney Hunt Inc. The floor stand used a combination of spur gearing and 90 degree bevel gearing to provide two input speeds. Manual input is by means of a hand crank which could be placed on either of the two input shafts. The gate can also be operated by means of an electric drill which is stored next to the gate operating stand within a small gate house situated on top of the embankment at the center of the dam. The operating mechanism is in excellent condition and has been obviously well maintained. The low level outlet sluice gate is guarded by a screen assembly consisting of five vertically oriented I-beams supporting removable screens which can be lifted out for cleaning. The total width of the screen area (excluding the width of the I-beams) is 115 inches. Both the screens and the steel guides are in very good contition.

In 1969, the present sluice gate hoist replaced the original hoist which was installed in 1923. The original hoist utilized a large handwheel for motive power. The original gate stem is still being stored in the gate operating house, even though it is not interchangeable with the present stem.

Although the sluice gate was not operated at the time of this inspection, the operator stated that it was in good working order and that he had opened it partially a few days earlier in order to draw the reservoir level below the spillway for this inspection.

In general the equipment appeared to be in excellent condition. Low level outlet discharges are estimated from curves correlated to lake surface elevations and gate openings.

d. Reservoir Area

The reservoir rim is densely wooded and sparsely developed along the shore line, which is in a natural state. The lake rim slopes are flat to about 5 feet above the lake surface and moderately steep above that level. No signs of instability could be readily detected along the slopes adjacent to the lake shore line. Some sedimentation is evident at the spillway approach, but not in sufficient amount to affect any hydrological or stability analyses.

e. Downstream Channel

The immediate downstream channel is narrow and shallow. The overbank slopes are approximately 1 on 4 horizontal and wooded. The roadway running south to New Durham crosses the river approximately 250 feet downstream of the dam and has a very limited water passage opening, and is considered inadequate for the possible spillway discharges. At flood levels, this bridge could control the tailwater downstream of the dam and lead to instability of the lower embankment. The small bridge opening is further susceptible to clogging and jamming by trees and logs. Approximately 5 to 7 residences are in the immediate downstream area of the dam in addition to Powder Mill Fish Rearing Station. The hamlet of New Durham is 3.5 miles downstream along the Merrymeeting River. Its current population is estimated at 200.

3.2 Evaluation

The seepage of the embankment is of concern, even though the operator of the Fish Rearing Station has stated that the dam's seepage condition is stable and unchanged in the 28 years he has operated it, going back to 1950. It is unclear whether the addition of the new concrete facing wall on the upstream face of the dam has reduced seepage volumes. It is also not clear whether the seepage observed has any connection with the cobble drains installed under the embankment, according to available plans. Further investigations will be recommended to evaluate the source and seriousness of the seepage.

The channel reach of the river downstream of the dam is a potential source of falling trees and logs that could jam and plug up the opening in the roadway bridge below the dam.

Additional stone protection should be placed at the lower of the spillway chute slab where it meets the natural channel to eliminate the abrupt drop at that point which could lead to undercutting of the spillway chute slab.

The spillway walkway is a safety hazard and the planks should be firmly reattached to the pier and abutments and a handrail provided.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures

Merrymeeting Lake is currently used solely to supply a very limited amount of water to the Powder Mill Fish Rearing Station, estimated at 10 cfs on a year-round basis. Current demands are much less than in former times when power was generated at the site. Lake levels are maintained at specified seasonal levels by the superintendent of the fish rearing station. The lake is drawn down from its summer level of elevation 648 $\pm$ to elevation 645.5 in the early spring in anticipation of snowmelt inflows. The snow cover in the watershed is estimated in the spring, together with the water content of the snow and the low level outlet releases are adjusted to achieve the summer lake level by June 1st. Discharge rating curves for the low level outlet prepared by the NH Water Resources Board are used to estimate the discharge at partial gate openings. The lake level is read daily and records are forwarded to the N.H. Water Resources Board (NH-WRB) at weekly intervals.

4.2 Maintenance of the Dam

The dam is part of recreation area, and the N.H. Game and Fish Department has kept the dam in a very presentable condition. There is a well tended grass cover on the downstream embankment slope, down to the point where boggy and wet conditions caused by seepage make the mowing impossible.

The gate operating house is orderly and the gate hoist mechanism is well greased. The trash screens on the spillway crest and the low level outlet were free of debris.

Repairs have been made on an as-needed basis and have included the replacement of the low level outlet gate hoist, local concrete replacement of concrete at the upper part of the spillway and additional concrete facing on the upstream face of the dam.

4.3 Maintenance of Operating Facilities

The dam is tended by the staff of the Powder Mill Fish Rearing Station, and includes routine grass mowing, low level outlet gate hoist lubrication and operation and debris removal from trash screens.

4.4. Description of any Warning System in Effect

There is no warning system in effect that would warn downstream residents in case of dam accident. A telephone connection is maintained to the Selectmen of the Town of New Durham whenever significantly larger water volumes are released from the dam.

4.5 Evaluation

The operational procedures at the dam are simple fitting in with the simple facilities involved. In line with greater public interest in dam safety, the owner should institute an annual dam inspection utilizing a simplified version of the visual check list used in this inspection report. The reports should be kept on permanent files. Maintenance schedules should be drawn up and all visits to the dam logged in a permanent record, whether for maintenance or dam operation.

SECTION 5

HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design Data

The evaluation of the hydraulic and hydrologic features of the Merrymeeting Lake Dam was based on criteria set forth in the Corps Guidelines for Phase I inspections, and additional guidance provided by the New England Division, Corps of Engineers. The Probable Maximum Flood (PMF) was estimated from guide curves for probable maximum flood for New England region, based on past Corps studies. The PMF peak versus drainage area curves are presented in the section of hydrologic computations.

The PMF curve applicable for rolling areas was adopted for the estimation of PMF peak of the reservoir. The PMF vs. drainage area relationship can be expressed mathematically as follows:

$$Q = 2323 - 676.99 \log_{10} A$$

$$Qp = Q \times A$$

where:

Q = Unit peak discharge in cfs/sqare miles

Qp = Peak PMF discharge, in cfs, for the reservoir

A = Watershed area, in square miles, upstream of the dam axis

The computed peak discharge of PMF and one half of the PMF for a drainage area of 11 square miles using the above equation are 17,800 cfs and 8,900 cfs, respectively. A triangular shaped flood hydrograph was assumed for the inflow design hydrograph.

Both the PMF and one half of the PMF inflow hydrographs were routed through the reservoir by the modified Puls Method, utilizing computer program HEC-1. The peak outflow discharges for the PMF and one half of PMF are 8,182 cfs and 2,279 cfs, respectively. Both the PMF and one half of the PMF result in overtopping of the dam.

The reservoir stage capacity curve was constructed using comparisons of both dam inventory data and planimetered areas, measured from 15-minute quadrangle topography maps. Reservoir storage capacity included surcharge levels exceeding the top of dam assuming that the dam remains intact during routing. In the routing computations, the discharge through outlet facilities was excluded due to its insignificant magnitude, as compared to the spillway discharge and the PMF. The spillway rating curve and the reservoir capacity curve are presented in the section of hydrologic computations.

Since the spillway of the dam is incapable of passing the PMF or one-half PMF without overtopping the dam, an assessment of downstream hazards due to a flood wave that would result in case of a hypothetical failure was also estimated. The magnitude of the flood wave was estimated using generally accepted "rule of thumb" computational procedures established by the New England Division Corps of Engineers in combination with sound hydrologic engineering judgement. Flood routing of the dam break hydrograph for downstream areas are given in the section on hydrologic computations. The results of this computation shows that in the event of a hypothetical dam failure at the time the lake level is at the top of dam, a lake discharge of approximately 18,600 cfs

would be released. Flood stages in the downstream channel reaches are given in the following table:

TABLE 1

Distance downstream of Dam Axis (Miles)	Est. Flood Stages (Feet)
0.25	24.1
1.0	8.9
2.0	12.0
3.0 (New Durham)	12.3

The flood stages would affect the structural stability of buildings in the downstream reach whose foundations are below the hypothetical inundation level, and could cause large scale property damage and possible loss of lives.

b. Experience Data

According to the superintendent of the Powder Mill Fish Rearing Station the lake level has never exceeded elevation 648.5, or one foot above the spillway crest level in the 28 years he has worked at the site. The low level outlet has never been opened more than 22 inches in this time. These conditions indicate a maximum discharge of about 65 cfs over the spillway and about 145 cfs through the low level outlet.

c. Visual Observations

The spillway structure is well maintained but the spillway discharge chute and the channel downstream are subject to erosion at high spillway discharge volumes. The downstream bridge opening will probably control tailwater levels at high discharges.

d. Overtopping Potential

As indicated in Section 5.1.a., both the PMF and one half of the PMF, when routed through Merrymeeting Lake Reservoir, result in overtopping

the dam. The spillway and reservoir survharge capacities are too small to accommodate the peak flows. The PMF and one half PMF overtopped the dam by 6.60 feet and 1.80 feet, respectively. (This may or may not affect the stability of the structure). One inch of runoff is equivalent to 0.5 feet rise in the lake; therefore, the minimum surcharge represents about 4 inches of runoff or about 20 percent of the PMF. Since the PMF is the Spillway Design Flood (SDF) for this dam, according to the Recommended Guidelines for Inspection of Dams by the Corps, the spillway capacity of the Merrymeeting Lake Dam is considered inadequate.

It is recommended that further studies be made in order to establish the need for increased spillway capacity or increased height of freeboard permit greater surcharge storage, or a combination of the two.

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

The present condition of the dam suggests a stable structure to all outward appearances, however, the fact that seepage emerges from the embankment at near mid-height poses a question regarding the stability of the slope.

b. Design and Construction Data

Records made available indicate that the present structure was built over an existing drywall masonry structure in 1922 to 1923. A fairly complete set of progress reports describe the construction of the dam. While the specification states that sheeting may be used "if desired", and sheeting and cobblestone drains are both shown on construction drawings, the progress reports do not mention the installation of either. Reference is made to placing a cutoff wall to a depth of 3.7 feet below the upstream invert of the penstock. The cutoff is said to have been placed on rock and blue clay. It is stated in the progress reports that blue clay as well as bedrock were encountered upstream of the dam. It is further stated in the report of August 30, 1923, that, upon the completion of the dam, seepage was observed at the end of the penstock. The construction reports do not, however, indicate what material was used in the embankment section. The upstream face of the dam has been resurfaced in 1969 without eliminating the seepage problem.

c. Operating Records

Operating records made available provided no information pertaining to structural stability.

d. Post Construction Changes

Insufficient data relating to post-construction changes is available to assess the affect on stability. Documentation is needed to evaluate the addition of the upstream facing concrete.

e. Seismic Stability

The dam is located in Seismic Zone 2 and, in accordance with the Recommended Phase I Guidelines, does not warrant seismic analyses.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition

The overall physical condition of Merrymeeting Lake Dam is fair in spite of its long history of seepage. The dam's safety is in question since the combined spillway and low level outlet capacity with a 1.80 ft surcharge is only 20 percent of the PMF. The spillway discharge capacity has been estimated by current Corps of Engineers screening criteria, and the owner should determine the spillway capacity by more sophisticated and accurate methods and procedures.

The tailwater at the dam is affected by the inadequate capacity of the roadway bridge opening downstream of dam which could cause embankment toe sloughing and slumping at high discharges. The inadequate roadway bridge opening can be further restricted by falling trees or logs in the reach between the dam axis and the bridge.

b. Adequacy

The lack of in-depth engineering data did not allow for a definitive review. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing design and construction data, but is based primarily on visual inspection, past performance history and sound engineering judgment.

c. Urgency

The urgency of performing the recommendations and remedial measures detailed below.

d. Need for Additional Investigations

There is no need for further investigations in this phase of the program. Recommended investigations to be carried out by the owner are listed below.

7.2 Recommendations

It is recommended that the owner, within 12 months after the receipt of this Phase I Report, assemble the following information, if the data can be found.

a. Data Acquisition

(1) An updated as-built set of drawings of the dam showing all pertinemt details and correcting inadequacies and omissions on the presently available drawings.

(2) Additional topographic surveys should be made in the reach downstream of the dam axis including details of roadway bridge downstream of the dam .

(3) The phreatic level in the embankment should be determined by means of piezometers or observation wells.

(4) The amount of seepage emanating from the embankment should be channelized and collected at one point for volume measurement by means of a simple notched weir.

(b) Investigations

Determine the spillway capacity of the dam using more sophisticated and accurate methods than were used in the Phase I screening methodology employed in this report, including the routing of the inflow through the lake.

Based on the results of the spillway capacity analyses, the owner should formulate plans for augmenting the spillway capacity, if shown necessary.

7.3 Remedial Measures

a. Alternatives

The alternatives for correcting the dam seepage and high phreatic levels in the embankment are:

(1) Elimination or reduction of seepage by installation of a steel pile cutoff on the upstream face of the dam and connecting it to the facing concrete.

(2) Elimination or reduction of seepage by installation of a clay blanket on the lake bottom upstream of the dam and connecting it to the upsream surface wall.

(3) Installation of toe drains and trenches on the downstream slope of the embankment to lower the phreatic line. Addition of riprap stones to the lower downstream slope for stabilization of the slope.

(4) Lowering the tailwater at the dam by providing a larger water way opening at the roadway bridge crossing downstream of the dam.

The alternatives available for augmenting the spillway capacity of the dam are:

(1) Provision of an additional auxiliary spillway on the left abutment.

(2) Widening the existing spillway on the right abutment.

(3) Lowering the existing spillway crest and addition of higher flashboards.

(4) Raising the dam elevation to permit greater heads and discharges over the spillway crest before overtopping.

(5) Seasonal lowering of the lake levels to provide additional storage in anticipation of large inflows.

(6) Combination of any of the above alternatives.

b. O&M Maintenance and Procedures

The owner should initiate the following programs:

(1) An annual inspection of the dam utilizing a visual check list similar to that used in this inspection report.

(2) Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

(3) Assemble and keep on hand complete documentation of the dam design, as-built drawings, and any other data pertaining to the dam safety.

(4) Selectively clear all trees adjacent to the spillway chute channel upstream of the roadway bridge, that could be uprooted during a large spillway discharge event and block the bridge opening. Clear all trees adjacent to the low level outlet channel that could be uprooted at times when the low level outlet discharges large water volumes.

(5) Improve the natural spillway channel in the reach between the concrete chute slab and the roadway crossing by adding riprap stone bank and bottom protection, widening the channel, and elimination of all sudden channel invert drops.

(5) Attach the spillway walkway planks to the piers and abutments and add a handrailing.

(6) The owner should establish a formal system with local officials for warning downstream residents in case of emergency. Round the clock surveillance should be provided by the owner during periods of unusually heavy precipitation.

APPENDIX A

CHECK LISTS:
- VISUAL OBSERVATIONS
- ENGINEERING, CONSTRUCTION MAINTENANCE DATA
- HYDRAULIC AND HYDROLOGIC DATA ENGINEERING DATA

CHECK LIST
VISUAL INSPECTION
PHASE 1

Name Dam MERRYMEETING LAKE DAM County Stafford State New Hampshire Coordinators

Date(s) Inspection June 6, 1978 June 7, 1978 Weather Sunny Cloudy, Rain Temperature 75°F both days

Pool Elevation at Time of Inspection 647.83 M.S.L. Tailwater at Time of Inspection 629.6 M.S.L.

Inspection Personnel:

Seymour Roth, June 6 and 7
David Kerkes, June 6 and 7
Yin Au-Yeung, June 6
Lynn Brown, June 6
William Flynn, June 6
Franklin A. Alden, NH G & F Superintendent, Powder Mill Fish Rearing Station

Recorder: Seymour M. Roth

On June 7: 6,500 gpm (10 cfs) was diverted to fish hatchery via 14-in. ø lines.
The low level outlet was open 8 in. releasing approximately 30 cfs.

Note: NA means Not Applicable

CONCRETE/MASONRY DAMS (*)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SEEPAGE OR LEAKAGE	See notes under "Embankment"	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	See notes under "Embankment"	
DRAINS	See notes under "Embankment"	
WATER PASSAGES	Not applicable	
FOUNDATIONS	Silt-clay mixture, ground moraine, densified by natural compaction	

(*) The dam consist of a rebuilt concrete and masonry upstream cutoff wall with a near vertical face, and a downstream sand and gravel embankment.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	No surface cracks could be observed on the upstream face of the concrete cutoff wall above the existing lake level. Apparently, a new facing has been added since the original construction.	
STRUCTURAL CRACKING	None observed	
VERTICAL & HORIZONTAL ALIGNMENT	NA	Make detailed survey of upstream face of dam during low lake lavel conditions.
MONOLITH JOINTS	None observable	
CONSTRUCTION JOINTS	None observable	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	No surface cracking was observed.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	There is some local sloughing at the area of seepage on the downstream face of the dam.	
VERTICAL & HORIZONTAL ALIGNMENT OF THE CREST	The alignment of the crest is good vertically. The horizontal ablignment of the dam shows a 10-degree kink at the center of the dam.	
RIPRAP FAILURES	No riprap has been installed.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The embankment runs into natural ground at the right abutment and the spillway has been cut out of natural ground beyond the area of contact. A short 8-ft core wall continues the cutoff from the spillway crest into the abutment slope. On the left abutment, a core wall approximately 33-ft long continues beyond the embankment contact into near level ground. Junctions look good.	
ANY NOTICEABLE SEEPAGE	There is a general zone of seepage approximately 90-ft long on the downstream face of the embankment at a level about 10 to 12 feet below the top of dam. Volume of seepage is hard to estimate due to deep vegetation and widespread seepage length, but is estimated at more than 10 gpm.	Collect, monitor and measure seepage. Determine origin, if possible.
STAFF GAGE AND RECORDER	Lake levels are being recorded daily. Staff gage has been removed to prevent vandalization.	
DRAINS	None could be observed. There are longitudinal gravel drains under the embankment according to the drawings, but no visual evidence of the drains at the downstream could be detected.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CRACKING & SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The low level outlet was originally a reinforced concrete pipe that went further downstream. Currently, this pipe has been broken off at its retaining wall at the toe of the embankment slope.	
INTAKE STRUCTURE	Integrated into the upstream cutoff wall. All visible parts are in acceptable to good condition.	
OUTLET STRUCTURE	NA	
OUTLET CHANNEL	The outlet channel is narrow and shallow with no local bank protection. Trees are in the immediate overbank area.	Selectively remove all trees that could be subject to uprooting at high outlet discharge conditions or high tailwater conditions.
EMERGENCY GATE	None installed.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE WEIR	The weir crest concrete has been refurbished. The chute walls are of mortared masonry construction. Some cracking of mortar joints, and deterioration of joints is visible.	No action required.
APPROACH CHANNEL	Shallow abutment area of Merrymeeting Lake, no approach paving is visible.	
DISCHARGE CHANNEL	The discharge chute channel slab is 10-ft wide by 55-ft long, and is paved with rough finished concrete for the first 45 feet. The last 20 ft surface is concrete with smoother finish. The concrete is in good condition, no visible cracking or distress. The joint between the two sections is eroded. The natural channel downstream of the concrete chute drops two feet and is subject to erosion and could undercut the concrete chute.	Protect the natural spillway discharge channel with bank and bottom stone armoring. Eliminate all sudden grade changes by filling in with stone.
BRIDGE AND PIERS	The spillway bridge is a crude plank walkway placed over the crest of the spillway. Its construction is not substantial and it could easily be swept away at PMF level lake heights, thereby losing a convenient access to the low level outlet gate house.	Reattach the spillway walkway plank securely to piers. Add a hand railing.

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONCRETE SILL	Not applicable	
APPROACH CHANNEL	Not applicable	
DISCHARGE CHANNEL	Not applicable	
BRIDGE AND PIERS	Not Applicable	
GATES & OPERATION EQUIPMENT	Not Applicable	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
MONUMENTATION/ SURVEYS	None	
OBSERVATION WELLS	None	
WEIRS	None	
PIEZOMETERS	None	
OTHER	None	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENTATIONS
SLOPES	The reservoir rim slopes are moderate to a level of 3 to 5 feet above the lake elevation. No signs of instability of the rim formations are readily apparent.	
SEDIMENTATION	There is some sedimentation evident, but the almost constant use of the low level outlet passes some bottom sediments downstream.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The immediate channel downstream of the dam is narrow, approximately 10-foot wide and shallow. The roadway bridge some 250 ft downstream of the dam axis has an inadequate water passage and is considered an obstruction.	
SLOPES	The stream overbank channel slopes are moderately steep, approximately 4 on 1 vertical and wooded. The channel itself is poorly defined within the general valley.	
APPROXIMATE NUMBER OF HOMES AND POPULATION	Approximately 5 to 7 residences are in the immediate downstream reach in addition to tne N.H. Fish Hatchery Station. New Durham is approximately 3.5 miles downstream, with an estimated population of 200.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	Available as reconstructed in 1923.
REGIONAL VICINITY MAP	Available
CONSTRUCTION HISTORY	Available
TYPICAL SECTIONS OF DAM	Available
HYDROLOGIC/HYDRAULIC DATA	Not available
OUTLETS - PLAN	Available
- DETAILS	Section available, no details
- CONSTRAINTS	Not available
- DISCHARGE RATINGS	Available
RAINFALL / RESERVOIR RECORDS	Not available

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
DESIGN REPORTS	None available
GEOLOGY REPORTS	None available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None available
POST-CONSTRUCTION SURVEYS OF DAM	Not available
BORROW SOURCES	Unknown
SPILLWAY PLAN - SECTIONS	Available
- DETAILS	Not available

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
(continued)

ITEM	REMARKS
OPERATING EQUIPMENT PLANS AND DETAILS	Not available
MONITORING SYSTEMS	None
MODIFICATIONS	None
HIGH POOL RECORDS	Available from U.S.G.S. records
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None
PRIOR ACCIDENTS OF FAILURE OF DAM - DESCRIPTION - REPORTS	None known
MAINTENANCE OPERATION RECORDS	None available

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

Name of Dam: MERRYMEETING LAKE DAM

Drainage Area Characteristics: 11.0 square miles

Elevation Top Normal Pool (Storage Capacity): Elev. 648.5 (19,500 acre-feet)

Elevation Top Flood Control Pool (Storage Capacity): NA

Elevation Maximum Design Pool: Elev. 650.5

Elevation Top Dam: Elev. 650.5

SPILLWAY CREST:

a. Elevation Elev. 647.5 (permanent); Elev. 648.5 with flash boards
b. Type Concrete sill and chute
c. Width 3 feet (estimated)
d. Length 20 feet
e. Location Spillover Right abutment
f. No. and Type of Gates None

OUTLET WORK:

a. Type 48-inch diameter line
b. Location Center of embankment
c. Entrance Inverts Elev. 628.5
d. Exit Inverts Elev. 628.5
e. Emergency Draindown Facilities As above

HYDROMETEOROLOGICAL GAGES:

a. Type U.S.G.S. gage 01079000
b. Location Merrymeeting Lake
c. Records

MAXIMUM NON-DAMAGING DISCHARGE Estimated at 600 cfs

APPENDIX B

PHOTOGRAPHS

ALL PHOTOGRAPHS TAKEN ON JUNE 6, 1978

Photo 1 - View of the dam from the left abutment showing the upstream masonry wall and the downstream embankment wall.

Photo 2 - View of the left abutment, showing the spillway chute entrance area.

Photo 3 - View of the spillway chute from the downstream side. Note the section of the spillway with side walls in the background, and the drop in chute grade in the foreground.

Photo 4 - View of the downstream channel of the Merrymeeting River from the road crossing below the dam. The low level outlet dam embankment and the outlet gate house are in the background.

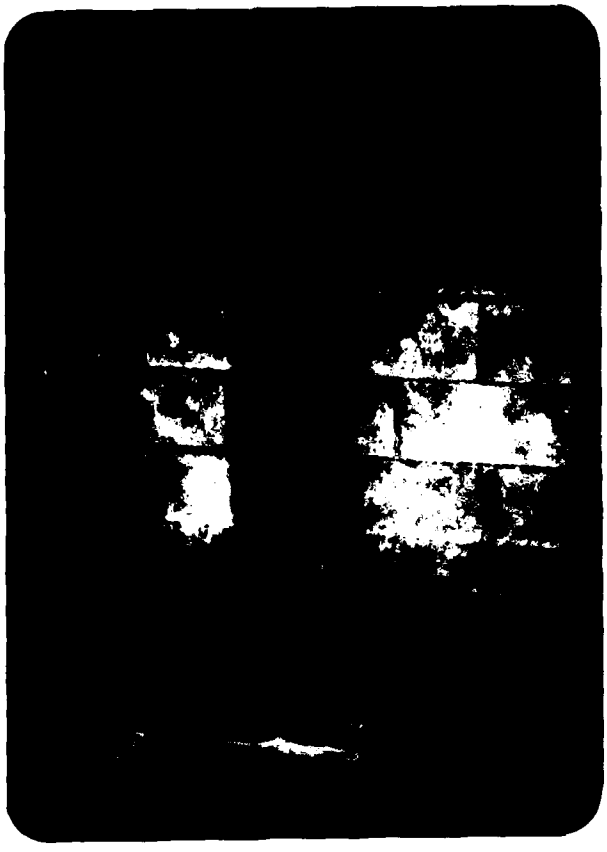


Photo 5 - View of the gate hoist inside the gate house.

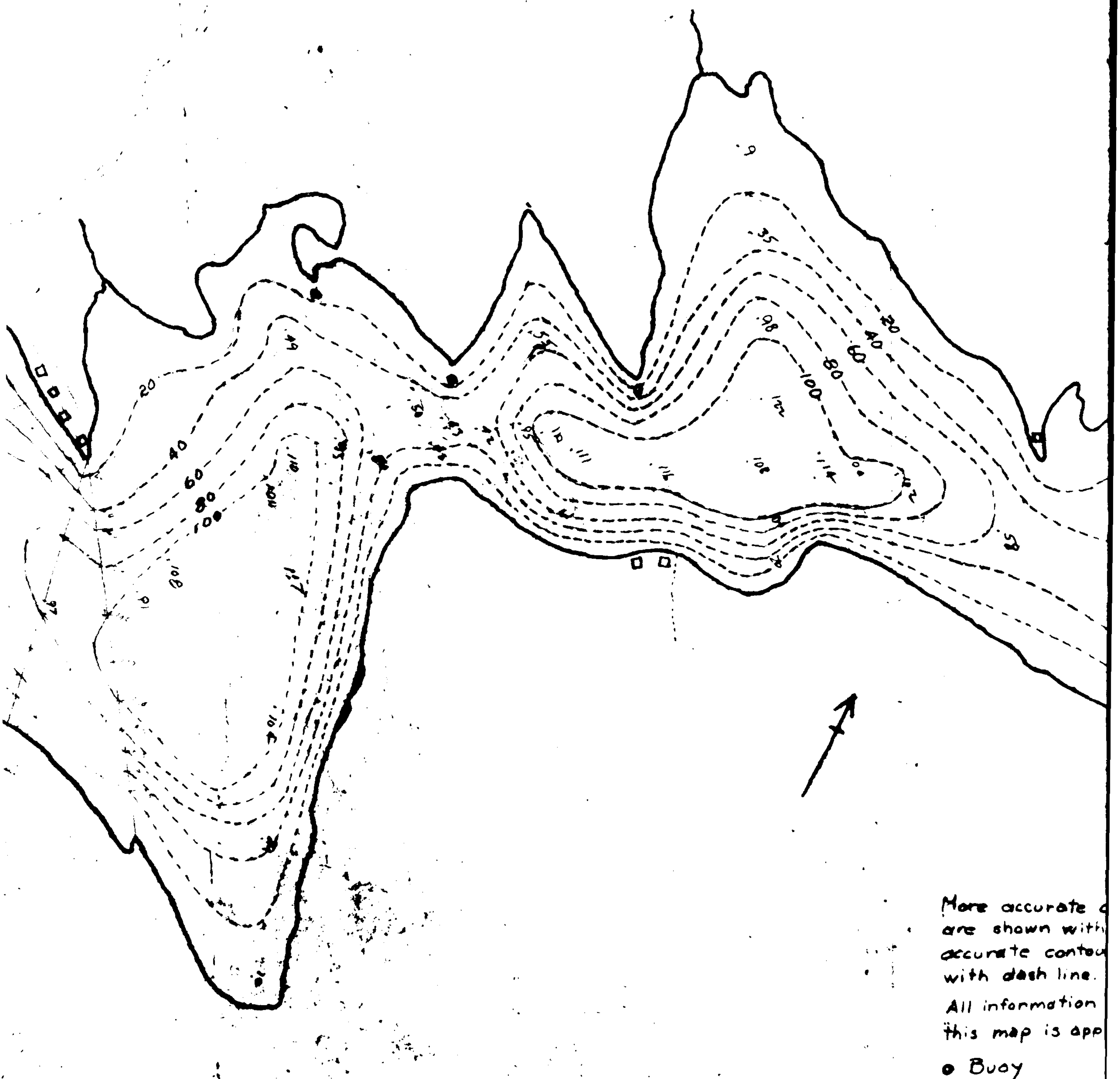
Photo 6 - View of Merrymeeting Lake rim taken from the dam axis.

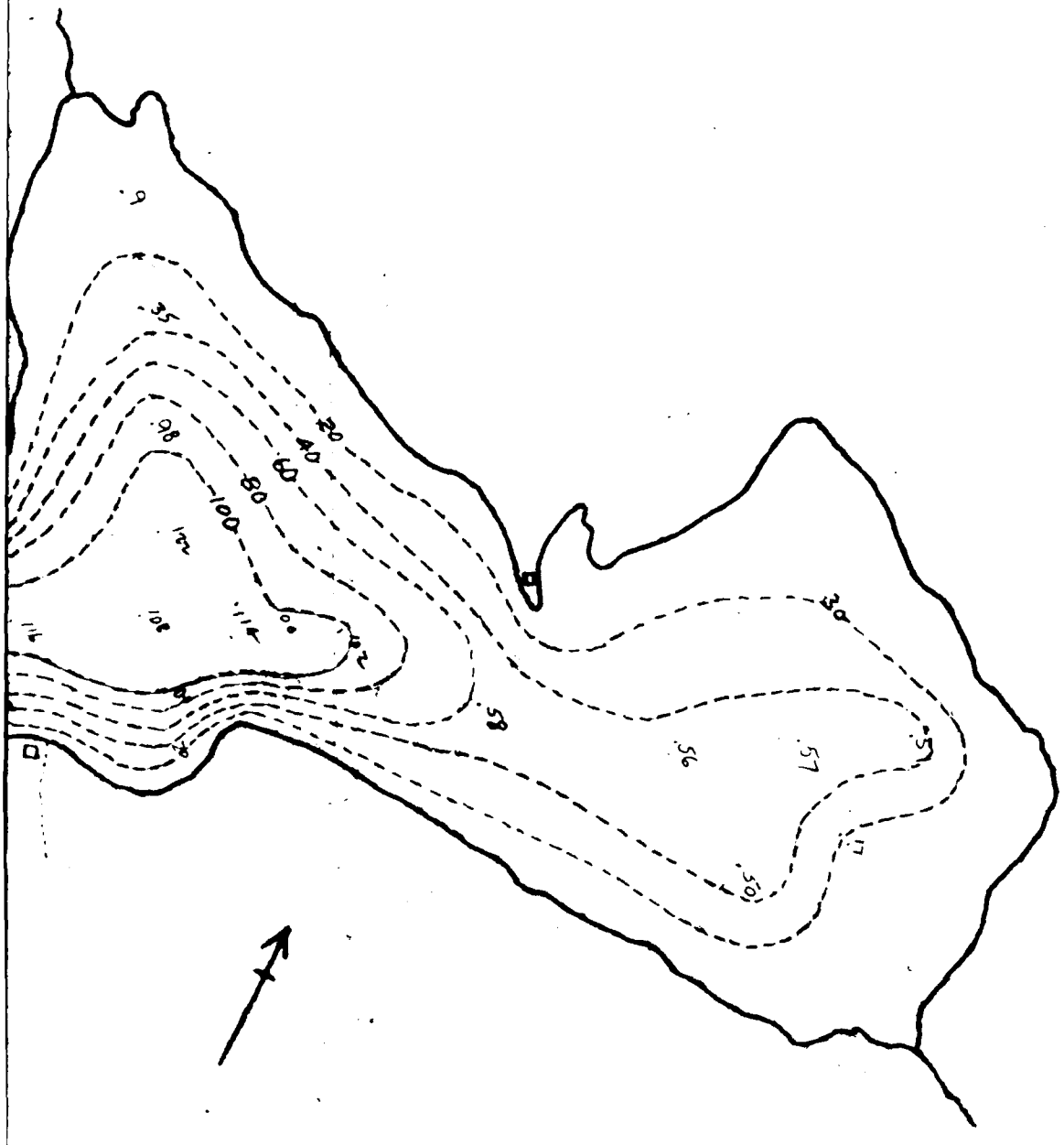
APPENDIX C

PLATES

PLANS & DETAILS OF DAM	Drawings 1, 2 & 3
Geologic Map	Drawing 4

20
40
60
80
100
Drawn By
Checked By


More accurate
are shown with
accurate conto
with dash line.
All information
this map is app
Buoy



178.01 DWG. NO. 1

More accurate depth contours are shown with solid line, less accurate contours are shown with dash line.

All information presented on this map is approximate

o Buoy

MERRYMEETING LAKE

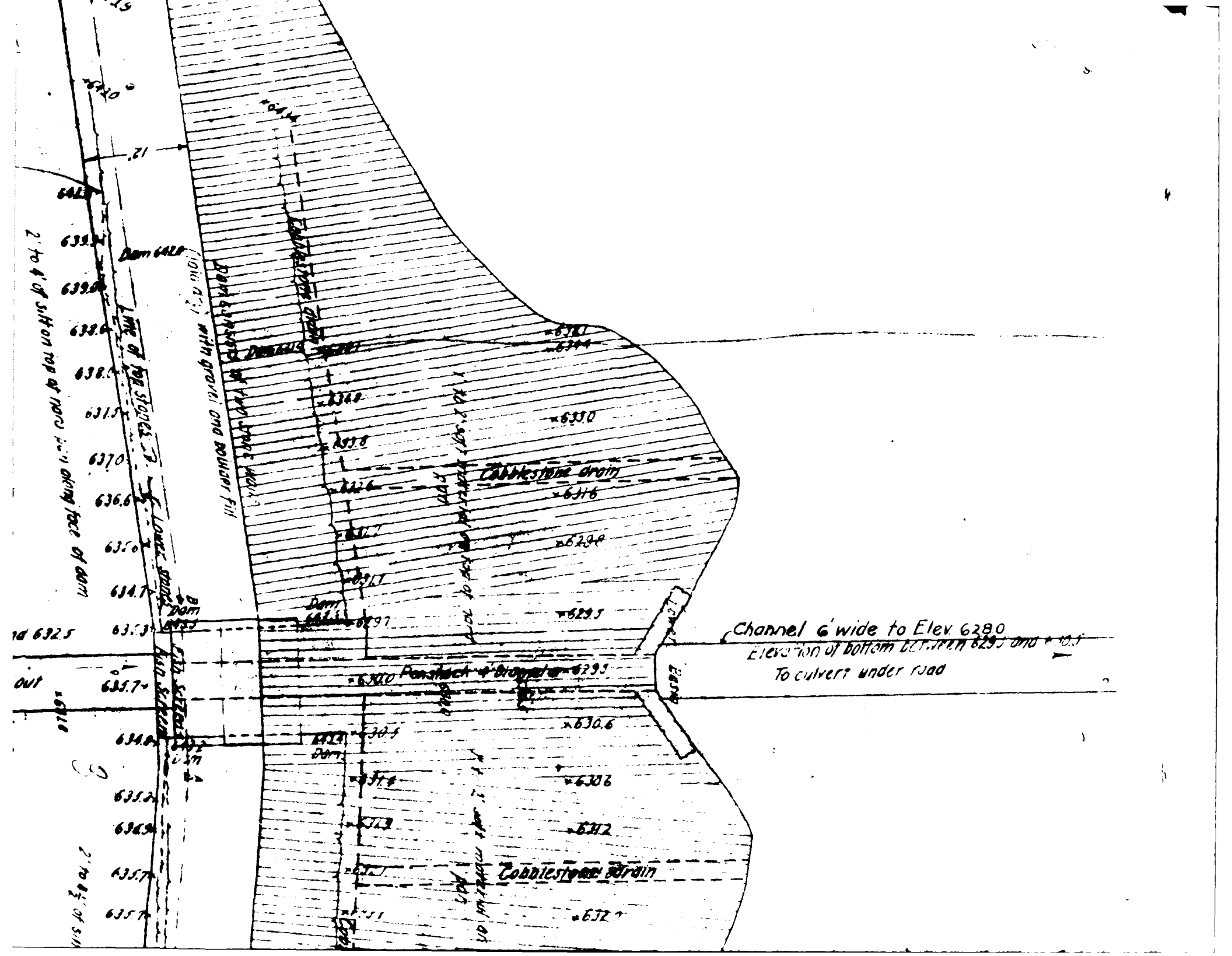
NEW DURHAM, N.H.

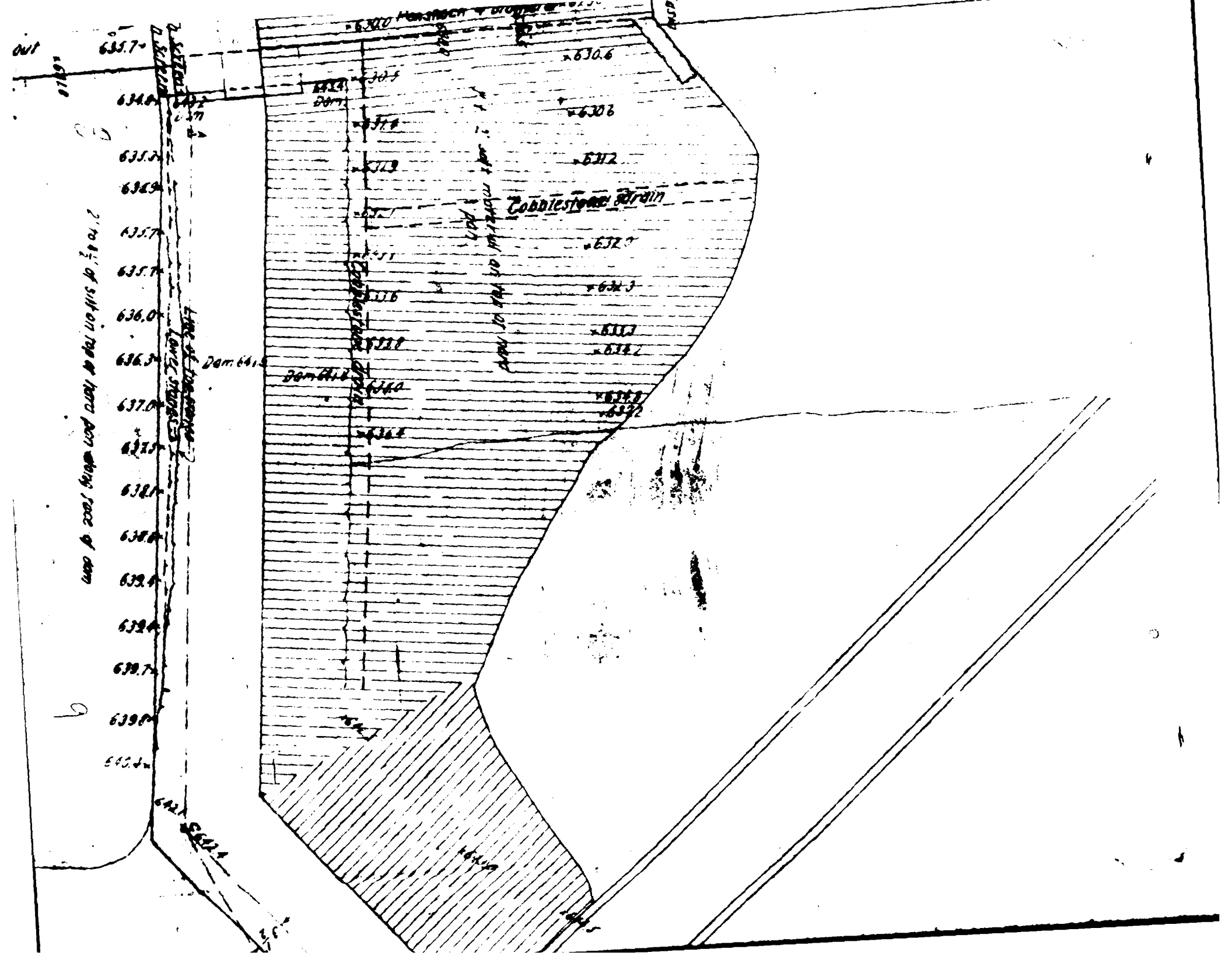
NEW HAMPSHIRE WATER RESOURCES BOARD

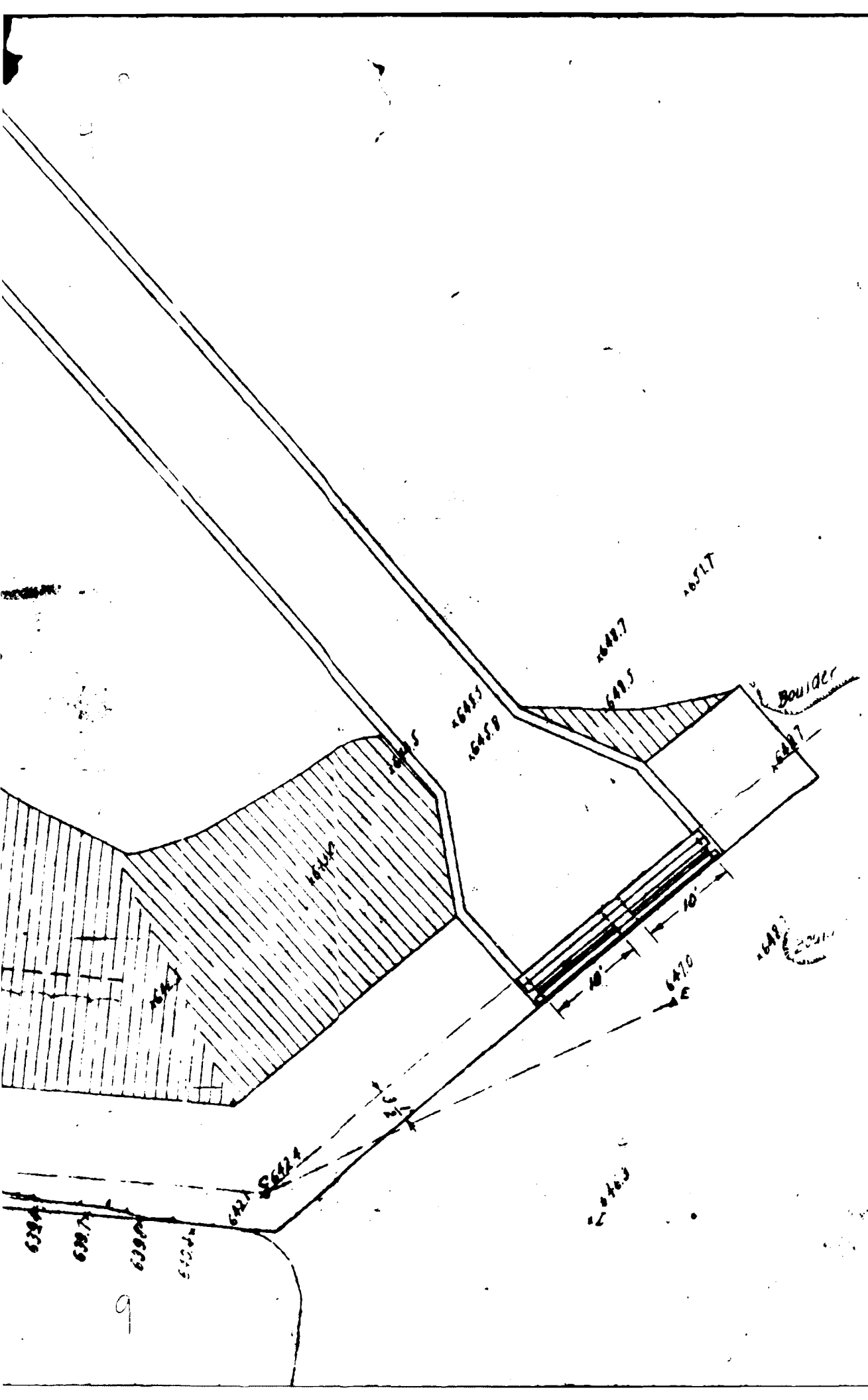
CONCORD, N. H.

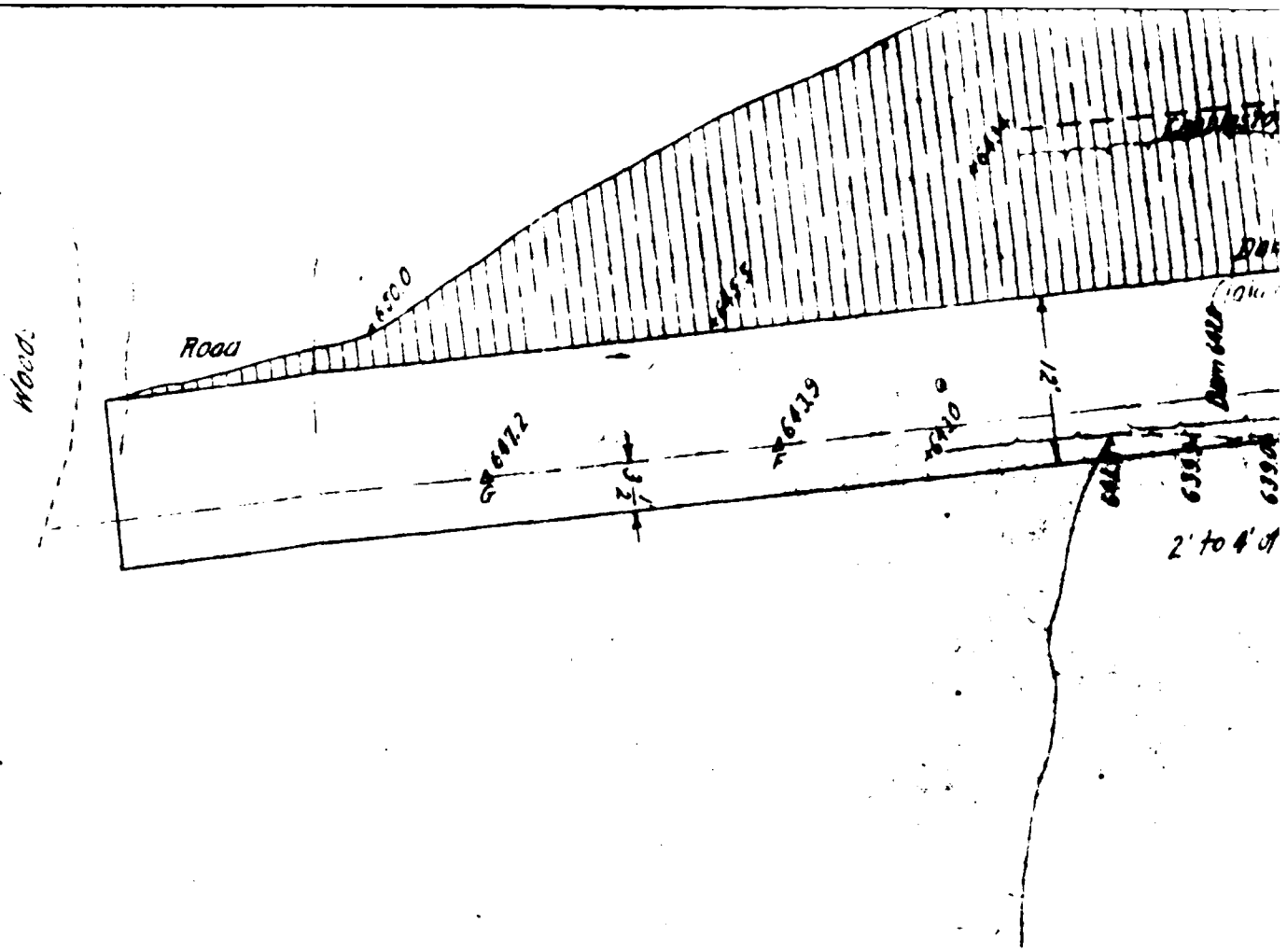
MARCH 1963	SCALE 1" = 1000' (APPROX)	

Road
12'
2'

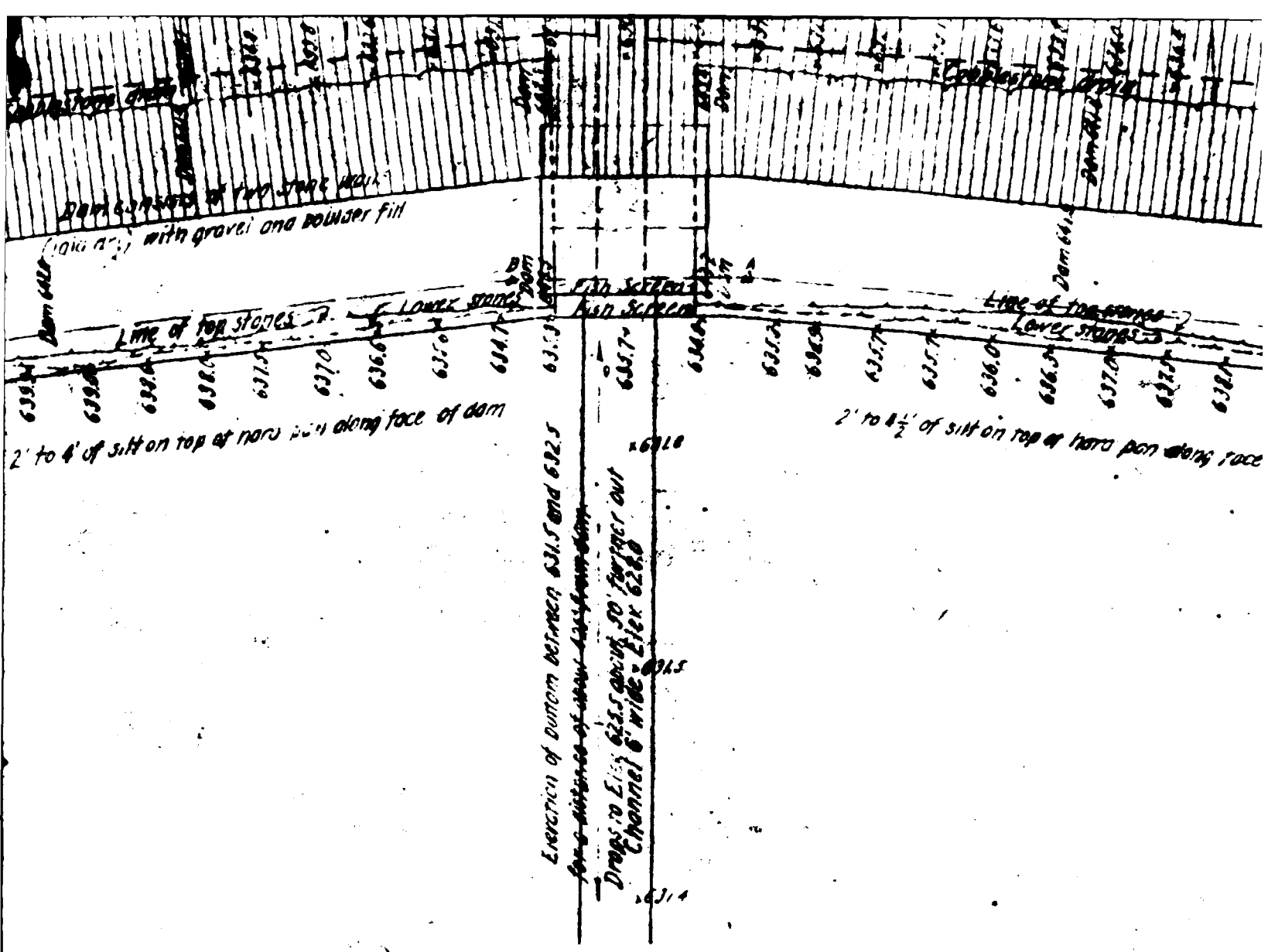

Cobblestone drain
Channel 6' wide to Elev. 6280
Elevation of bottom between 629.5 and
To culvert under road
Cobblestone drain

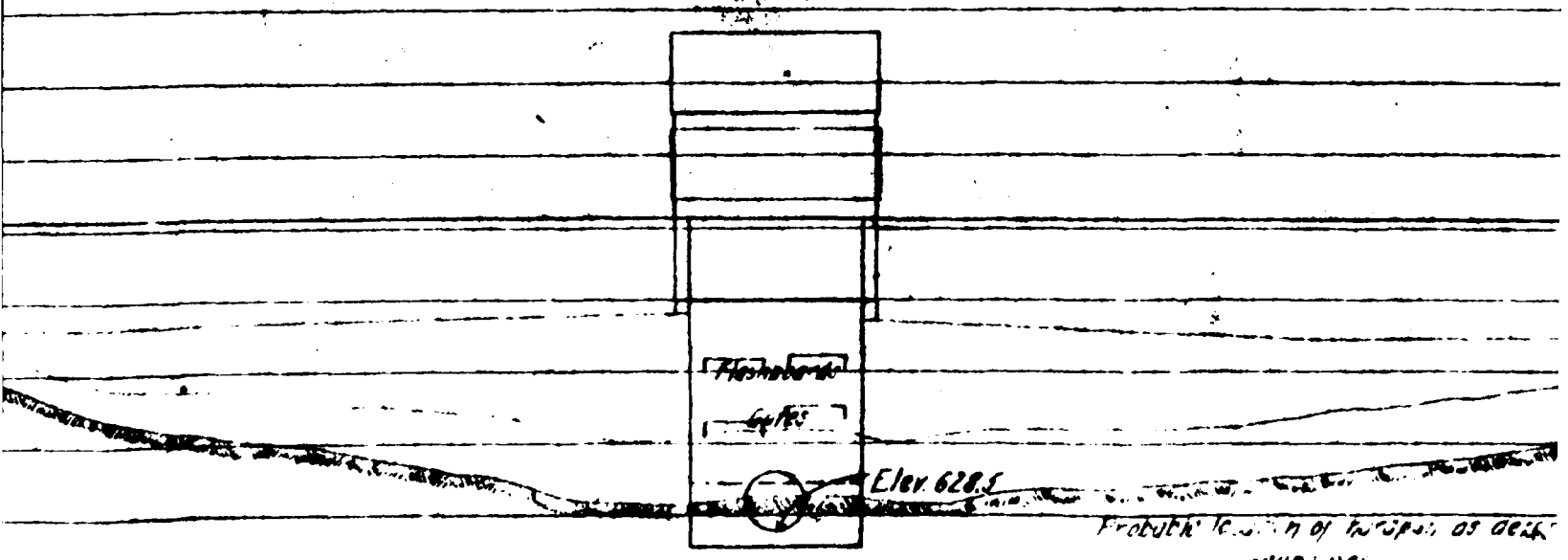

Cobblestone Stream
Dam
Dam
Dam

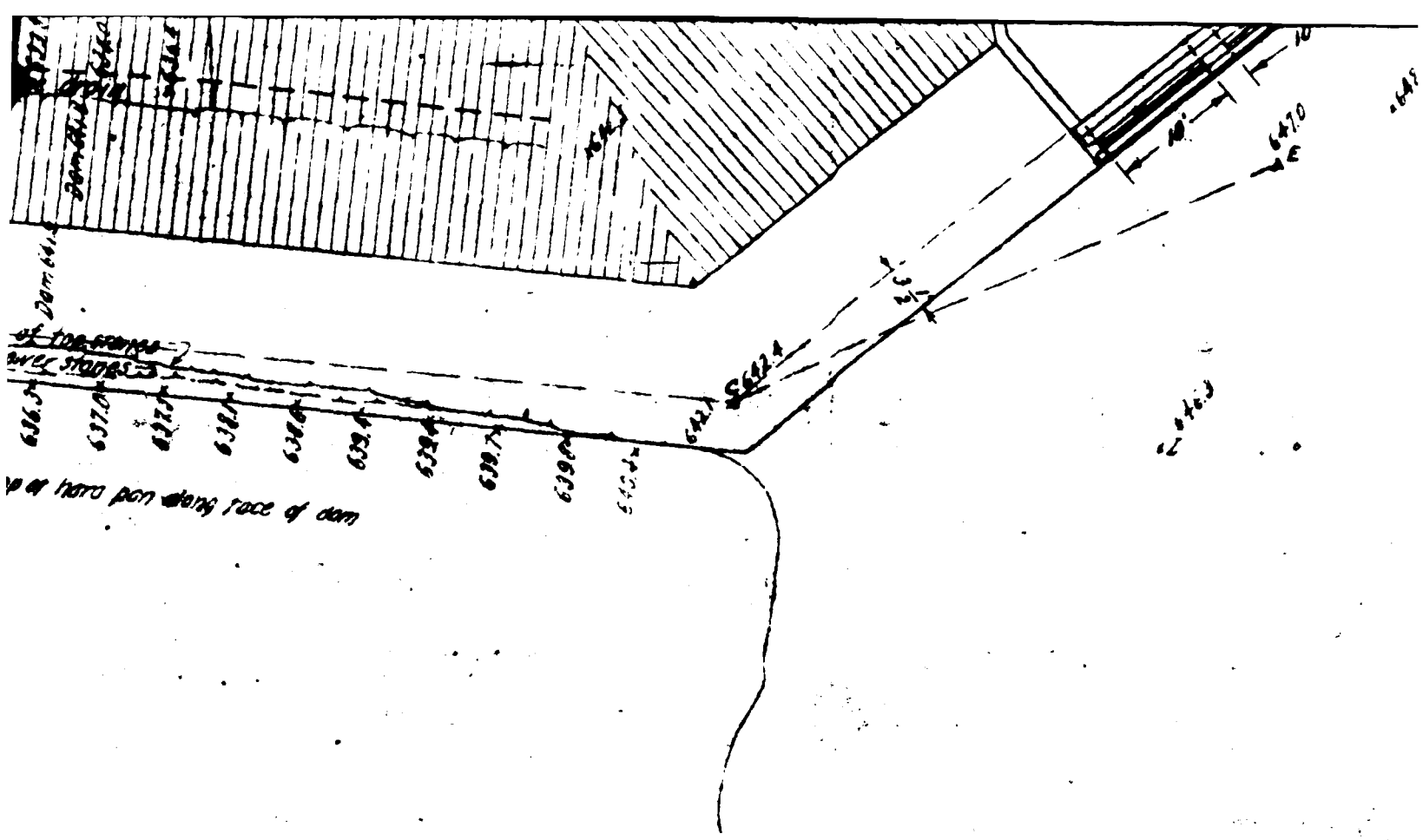

646.1
651.T
649.7
649.5
Boulder
649.7
649.5
649.8
649.5
649.2
10'
10'
647.0
649.2
649.2
646.3
642.4
642.2
639.4
639.7
639.0
9
10



665
660
655
650
645
640
635


Fish Screen
Fish Screen
Line of top stones
Lower stones
Line of top stones
Lower stones
2' to 4' of silt on top of horn pan along face of dam
2' to 4½' of silt on top of horn pan along face
Excavation of bottom between 631.5 and 632.5
Drops to Elev. 625.5 over 30' further out
Channel 6' wide, Elev. 628.5
631.4
Plan


Flashboards
Gates
Elev. 628.5
Probable location of trash as deck
Elevation

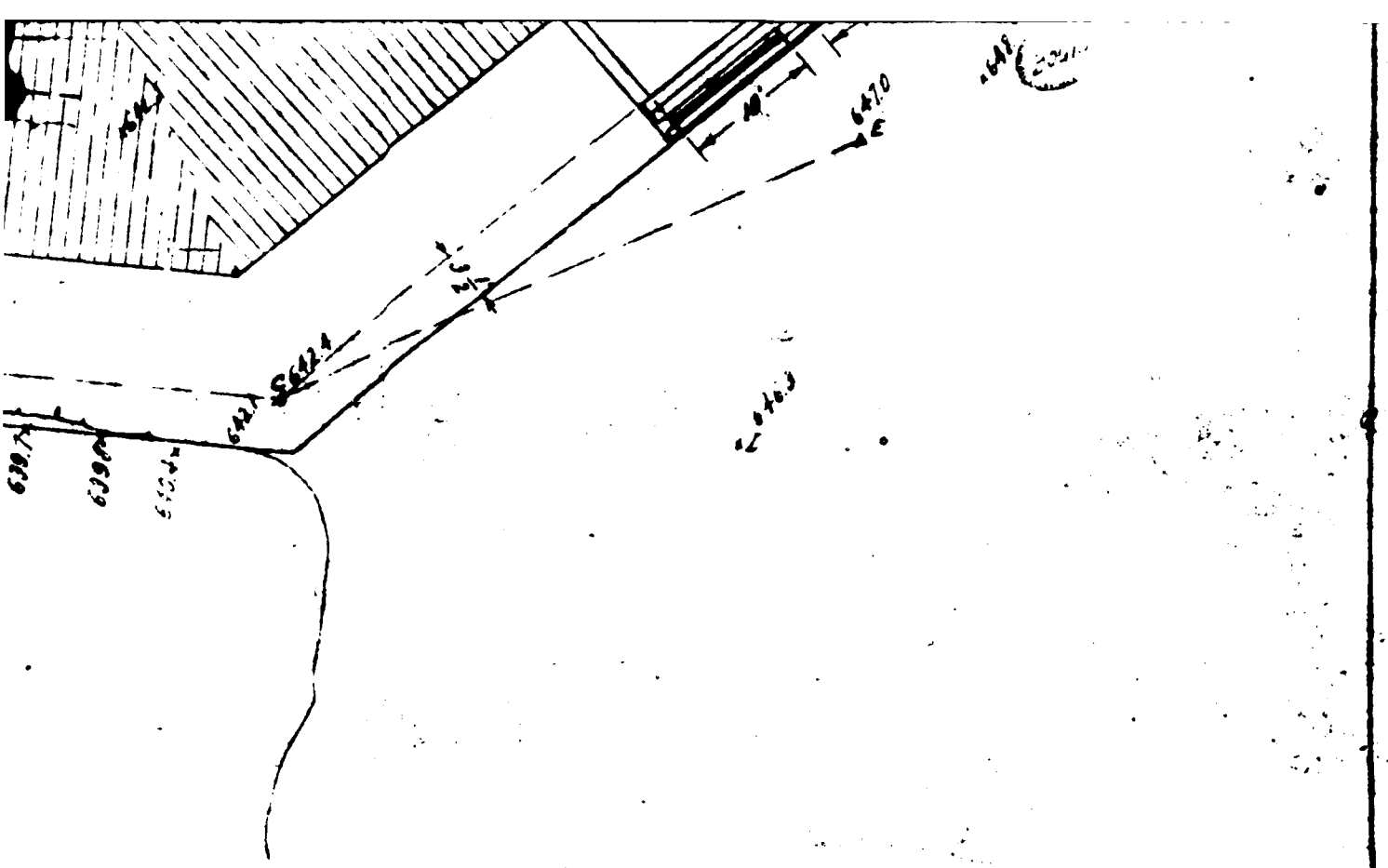


Plan and

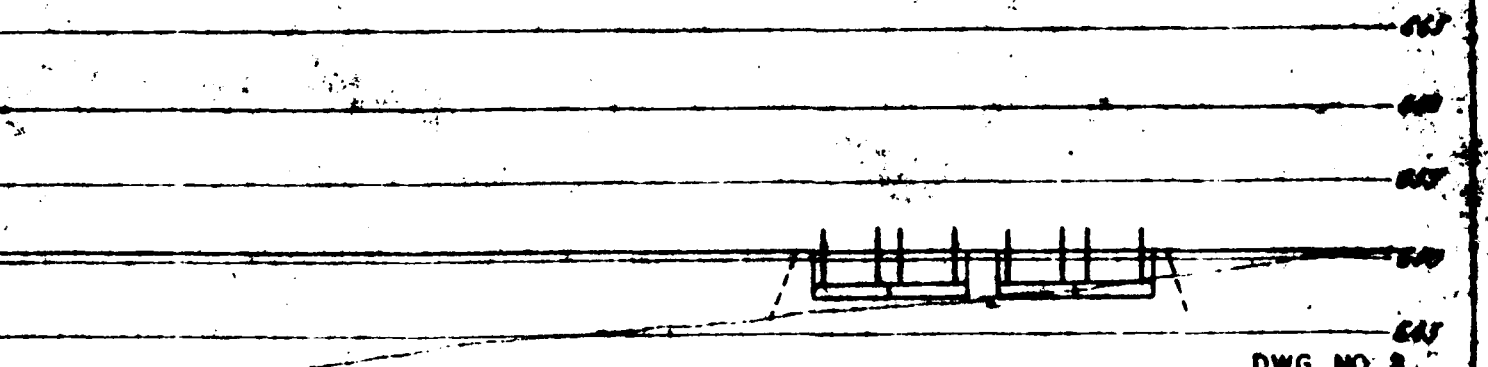
MERRYMEE

Drai...

7



Present construction shown in light lines.
Proposed construction shown in heavy lines.



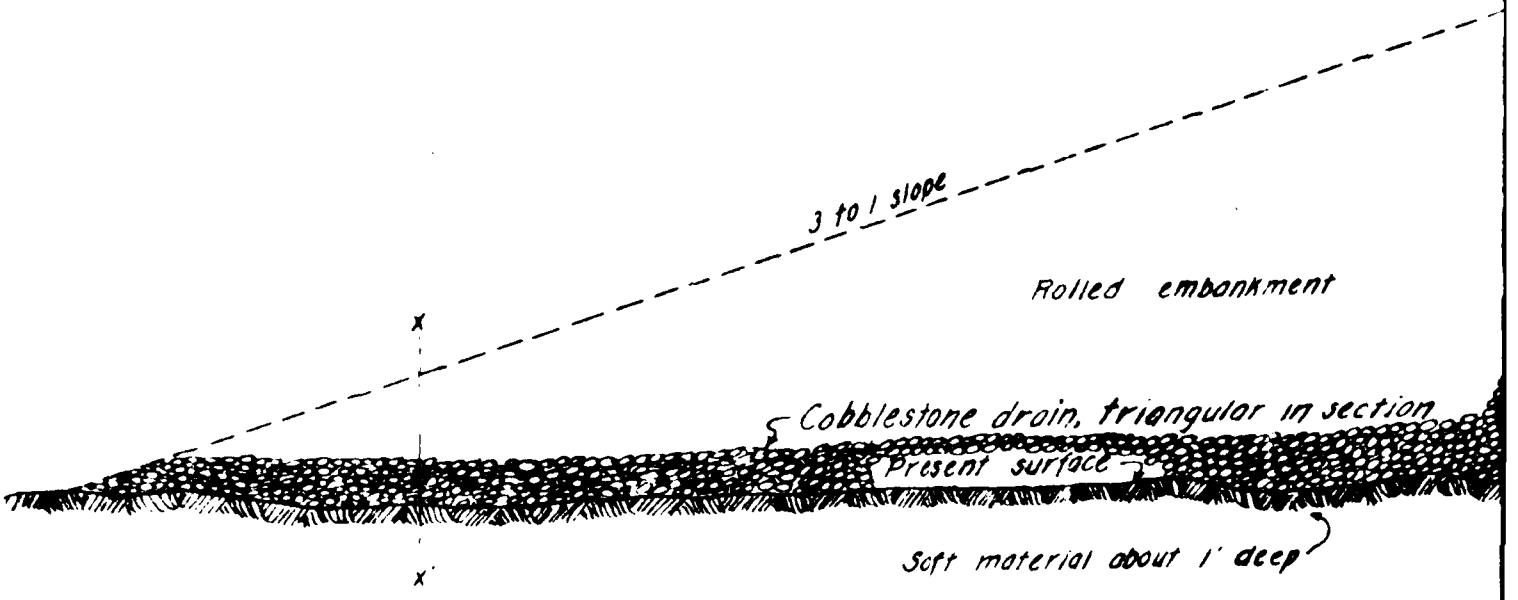
DWG. NO. 8.

Plan and Elevation

MERRYMEETING LAKE

Drawn ... 1922.

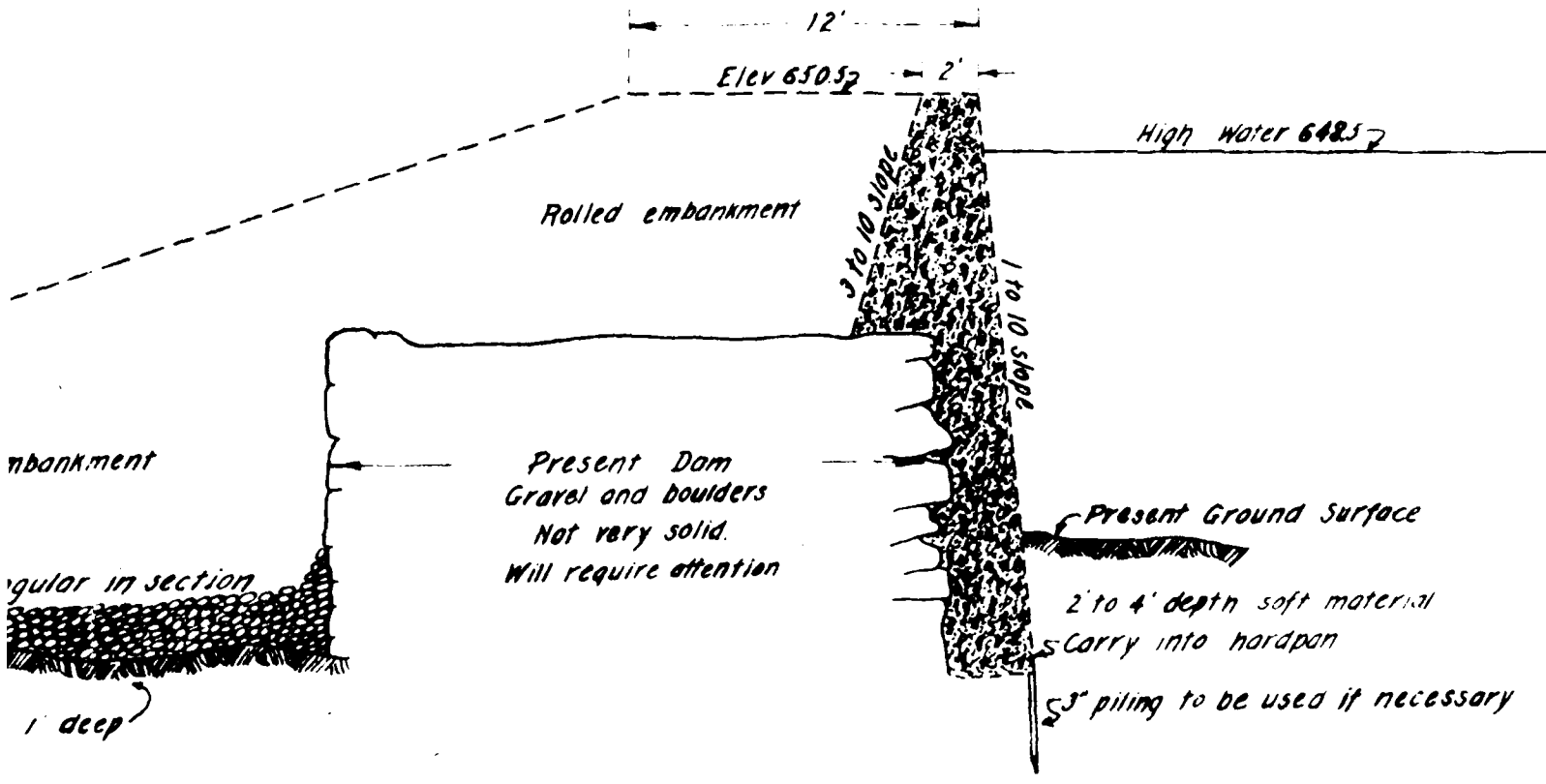
154-10



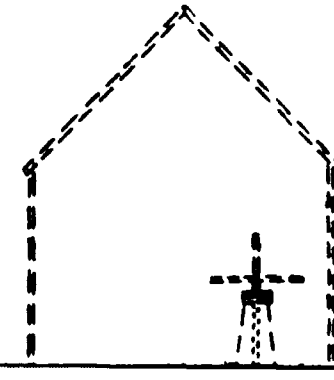
Typical
1" =

Earth Surface

Section of
X-X'
1" = 5'

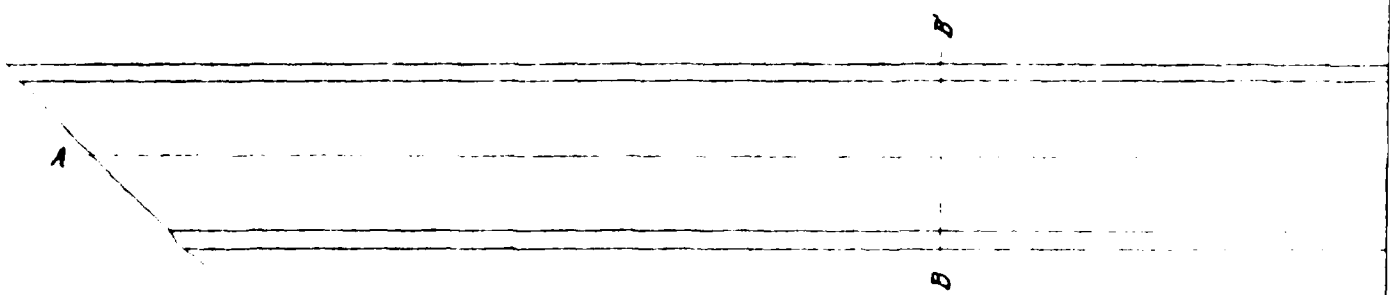


Typical Dam Section
1" = 5'

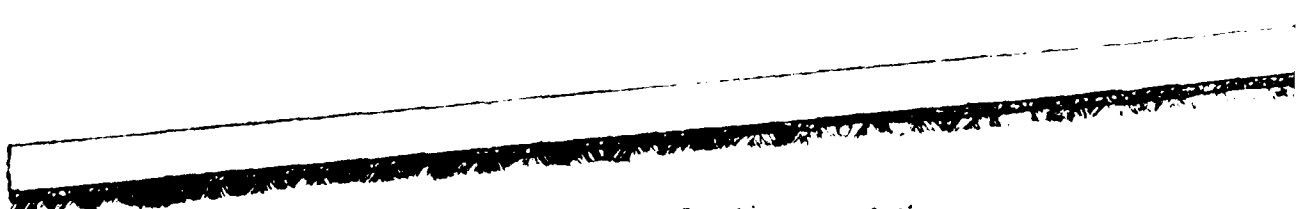


3

essary

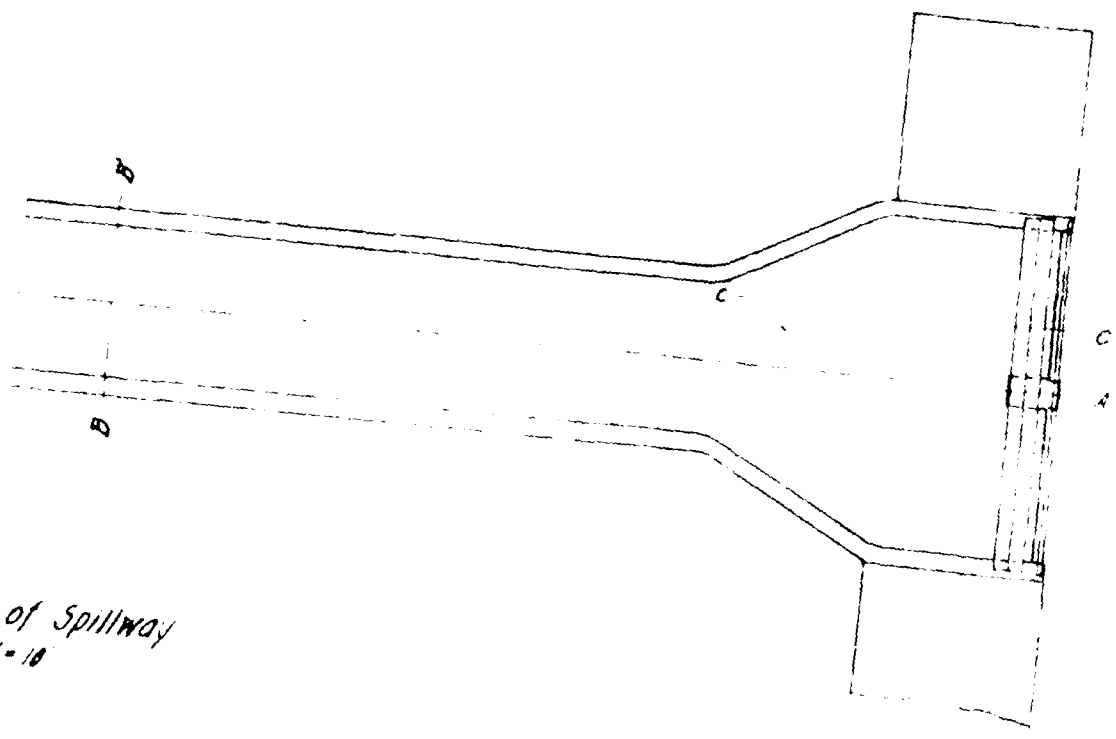


Plan of Spillway
1" = 10'

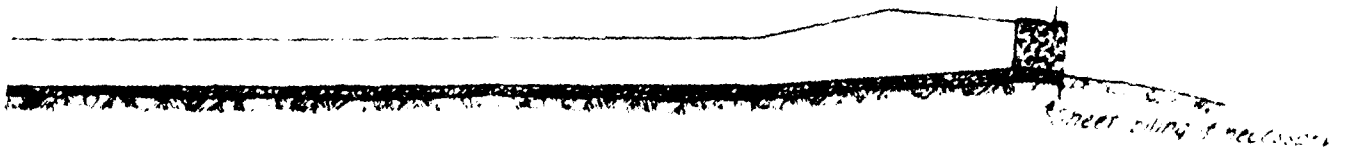


Section on A-A'
1" = 10'

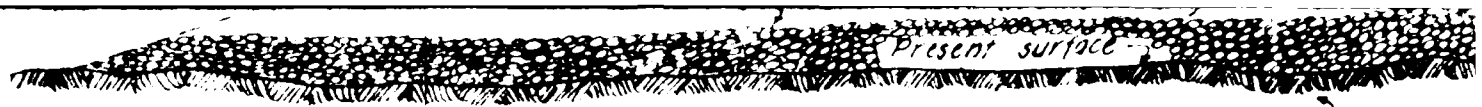
4



of Spillway
1" = 10'



on on A-A'
= 10'



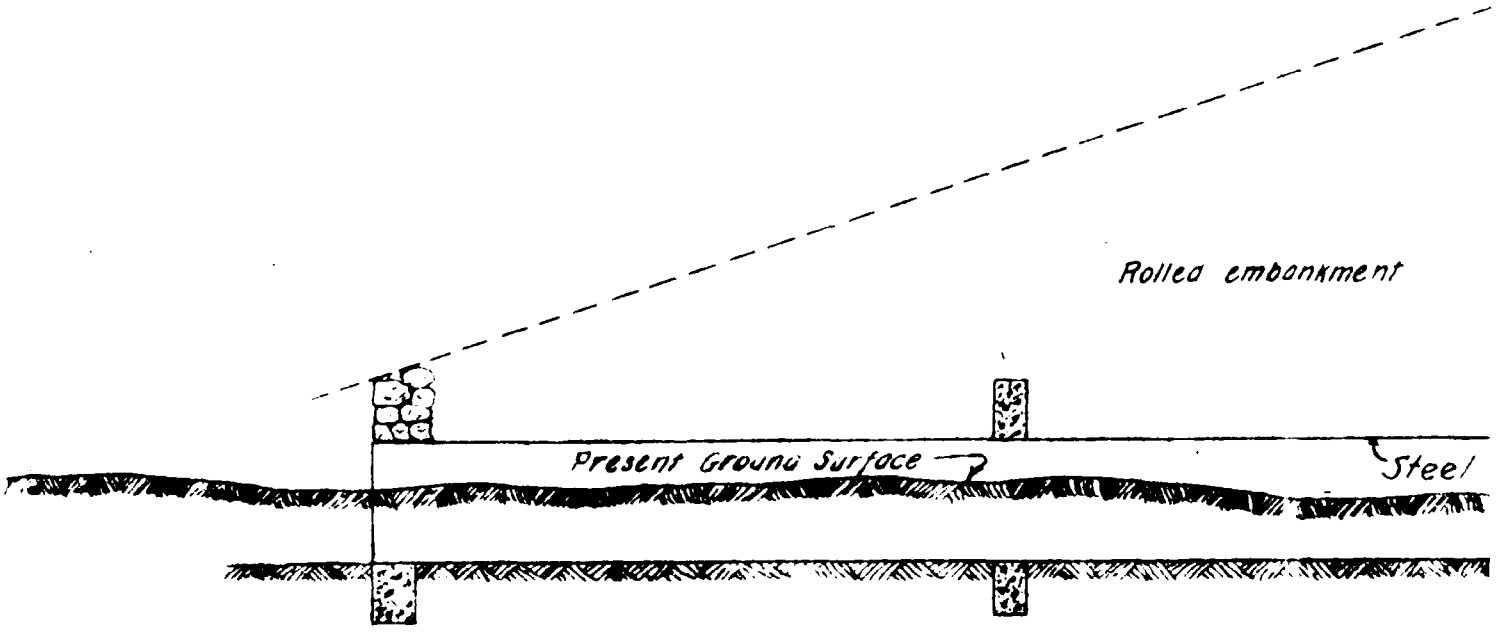
Soft material about 1' deep

X

Typical

Earth Surface

Section of
X-X
1" = 5'



Section

in section

Will require attention

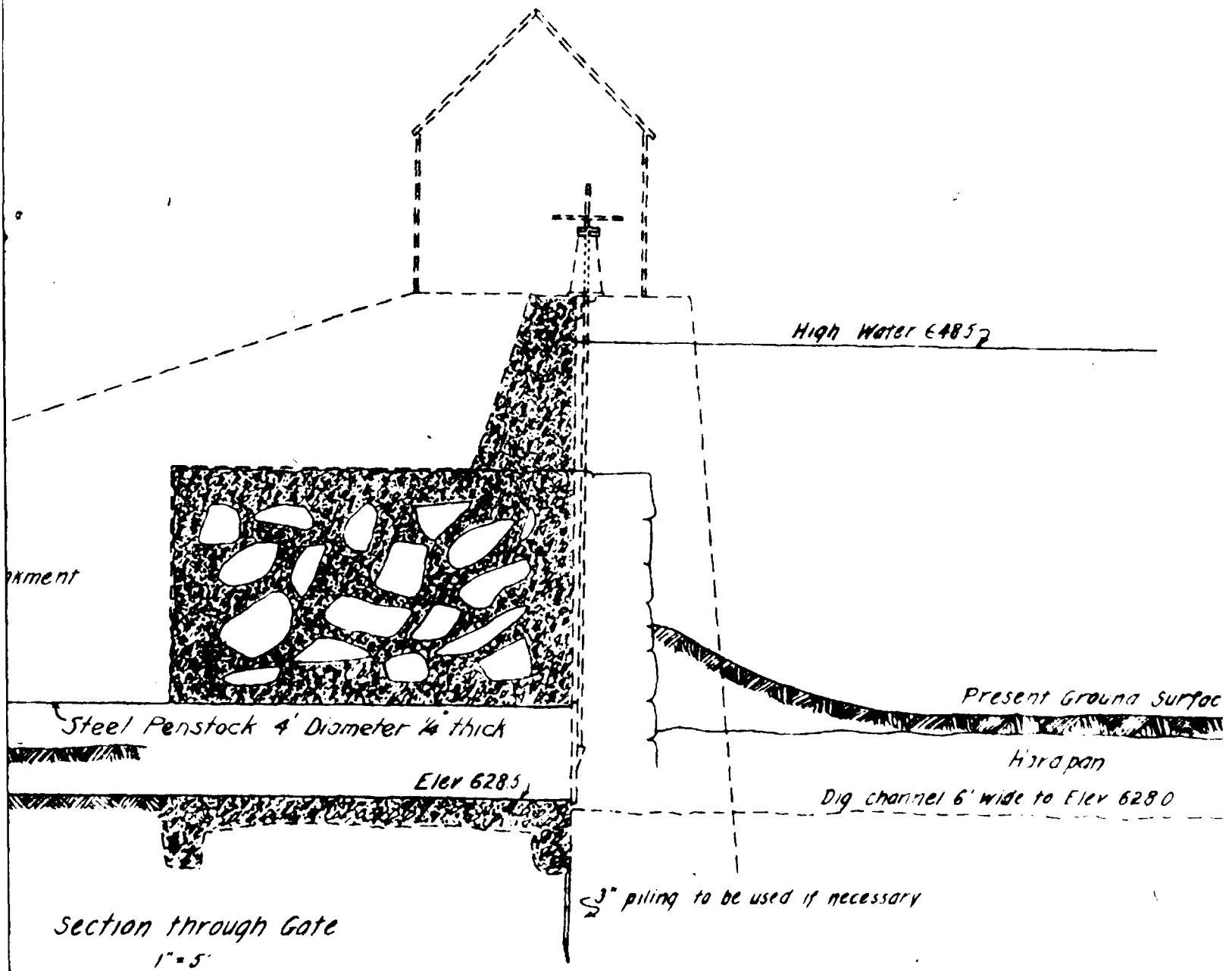
2' to 4' depth soft material

Carry into hardpan

3" piling to be used if necessary

ep

Typical Dam Section
1" = 5'

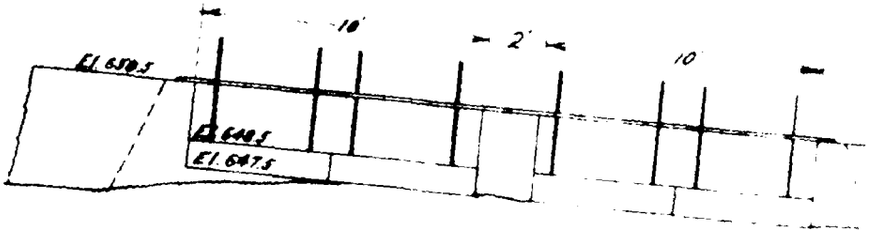


Section through Gate
1" = 5'

B

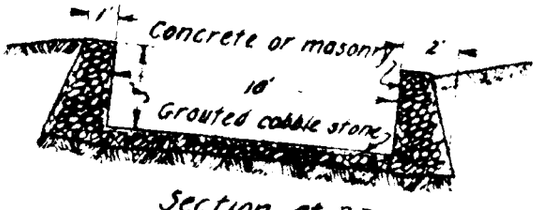
Plan of Spillway
1" = 10

Section on A-A'
1" = 10'



Front Elevation of face of Spillway
1" = 5'

6280



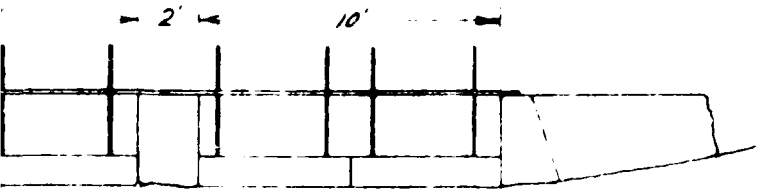
Section at B-B
1" = 5'

Section at CC'
= 5'

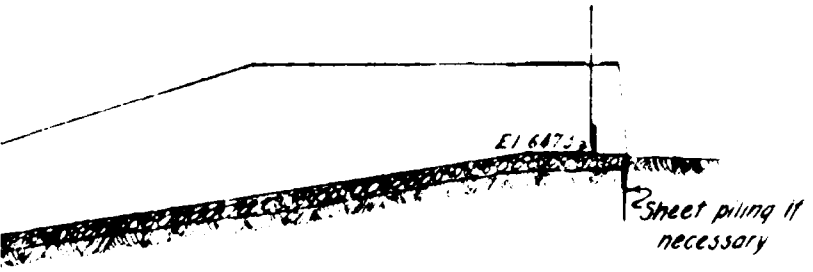
7

of Spillway
- 10

on A-A'
0'



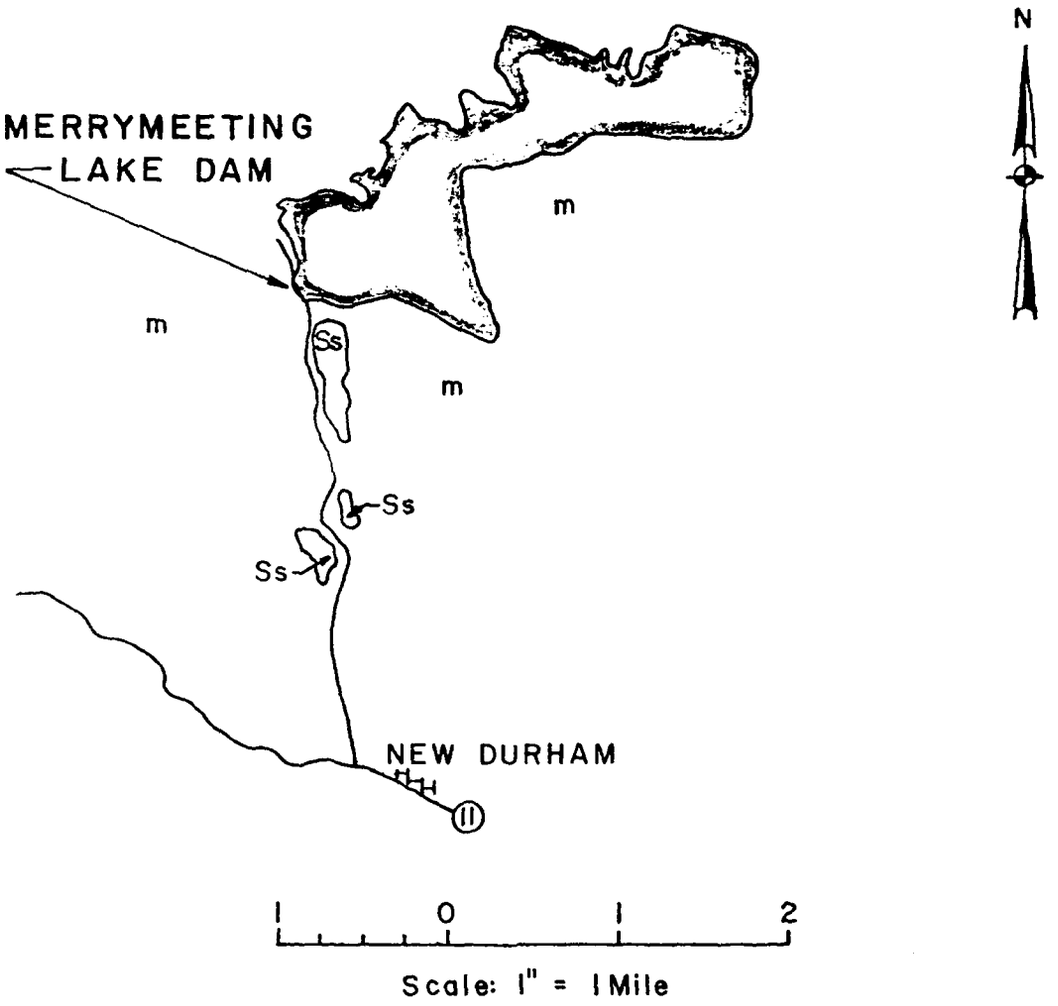
Elevation at head of Spillway
1" = 5'



Section at CC'
1" = 5'

DWG. NO 3

Sections of Dam and Spillway
Proposed Merrymeeting Lake Dam
Proprietors of Locks and Canals
Lowell Mass
Scales as noted
Drawn by J C M June 28, 19



LEGEND:

m	Ground Moraine (Till)
Ss	Stratified Sandy Gravel Deposits in Kame Terraces and Valley Trains
——	Contact

NOTE: Granites and Mica Schists Comprise Bedrock

GEOLOGIC MAP
MERRYMEETING LAKE DAM DWG. NO. 4

APPENDIX D

HYDROLOGIC COMPUTATIONS

DAM SAFETY INSPECTION
NEW HAMPSHIRE - MERRYMEETING LAKE DAM
HYDRO/HYDRAULICS / PMF

SHEET NO. ____ OF ____
JOB NO. 1211
BY YIN DATE JUNE 12

Maximum Probable Flood Peak Flow Rate.

According to NED General Curve

Assume rolling area:

Q = 2225 - 576.99 log A

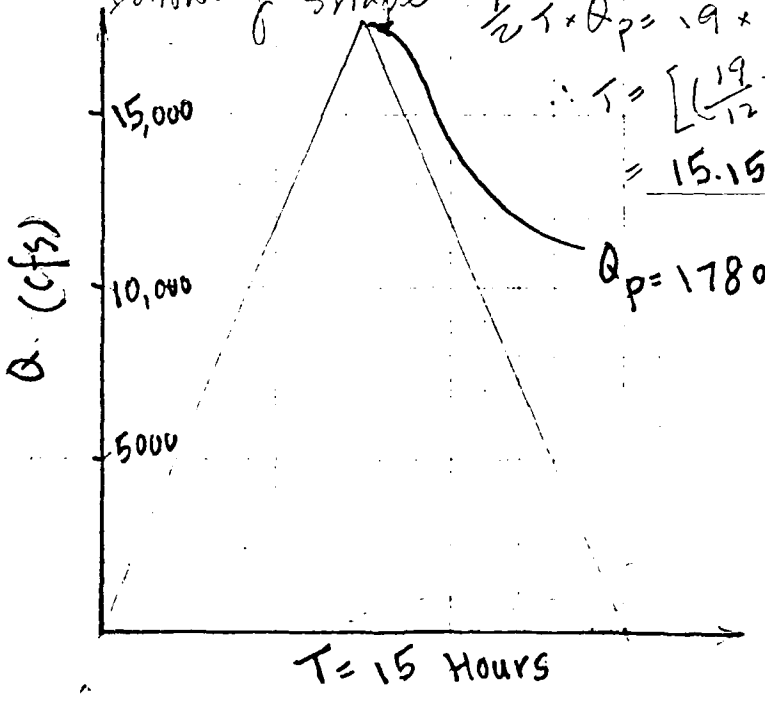
A = 11 sq. mile.

∴ Q = 1617.99 cfs/sq mile.

$Q_p = A \times Q = 11 \times 1617.99 = \underline{17,800}$ cfs

Since MPF runoff in New England equals approx 19 inches according to NED guideline.

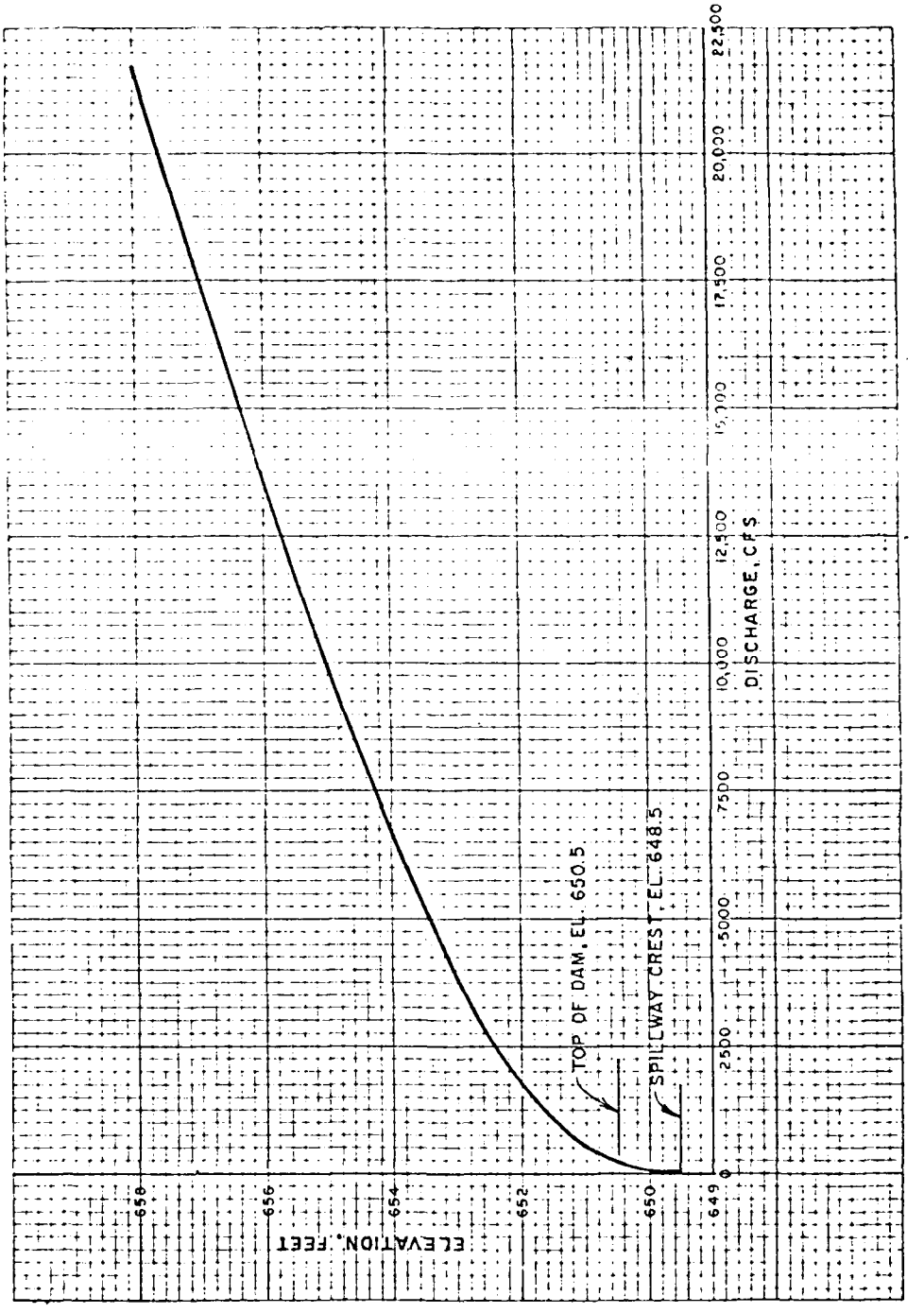
The triangular hydrograph will be approximate to the following shape:



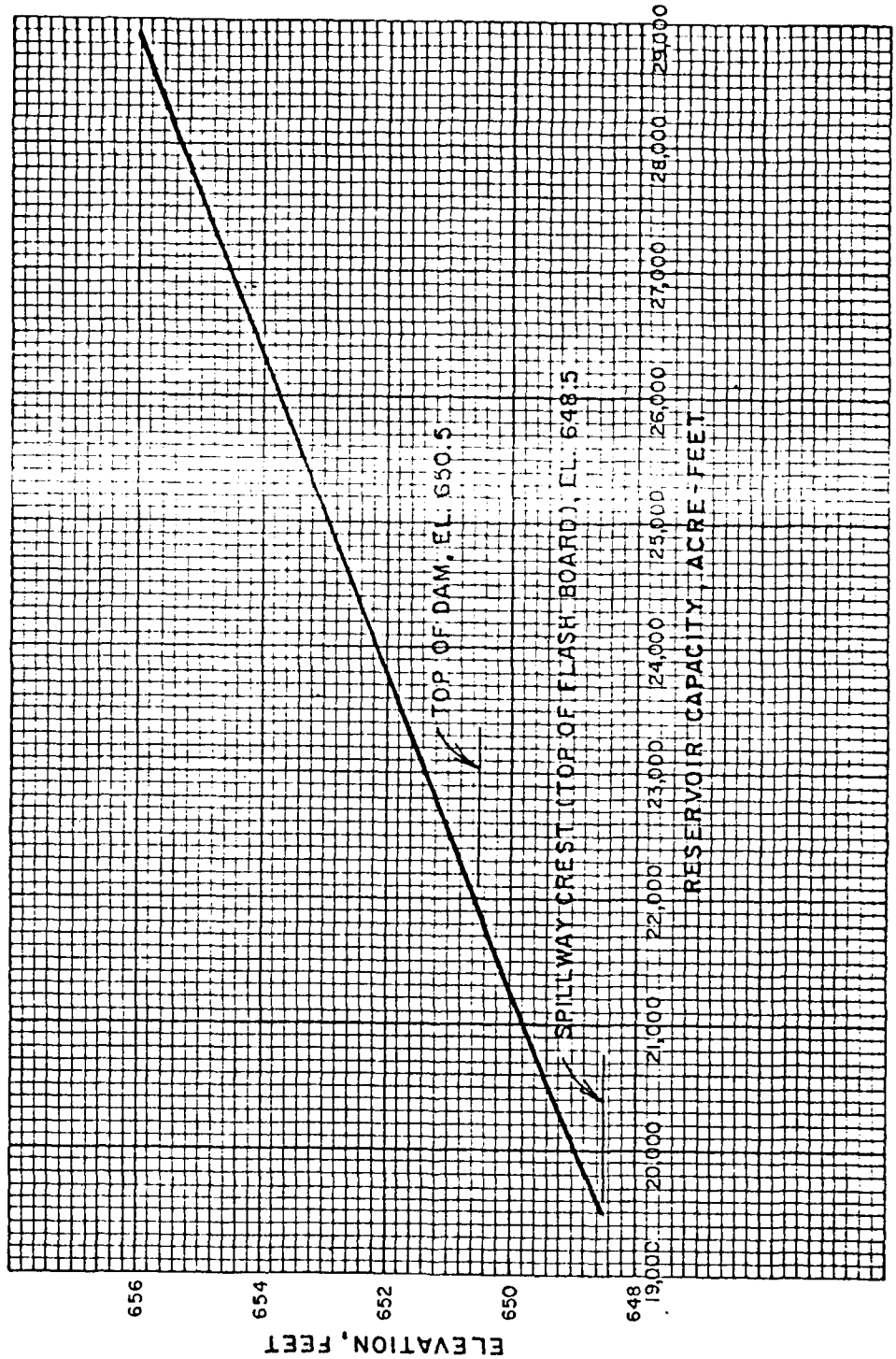
$\frac{1}{2} T \times Q_p = 19'' \times A$

$\therefore T = \left[\left(\frac{19}{12}\right) \times 11 \times 27,878,400\right] / 3600 \times Q_p$

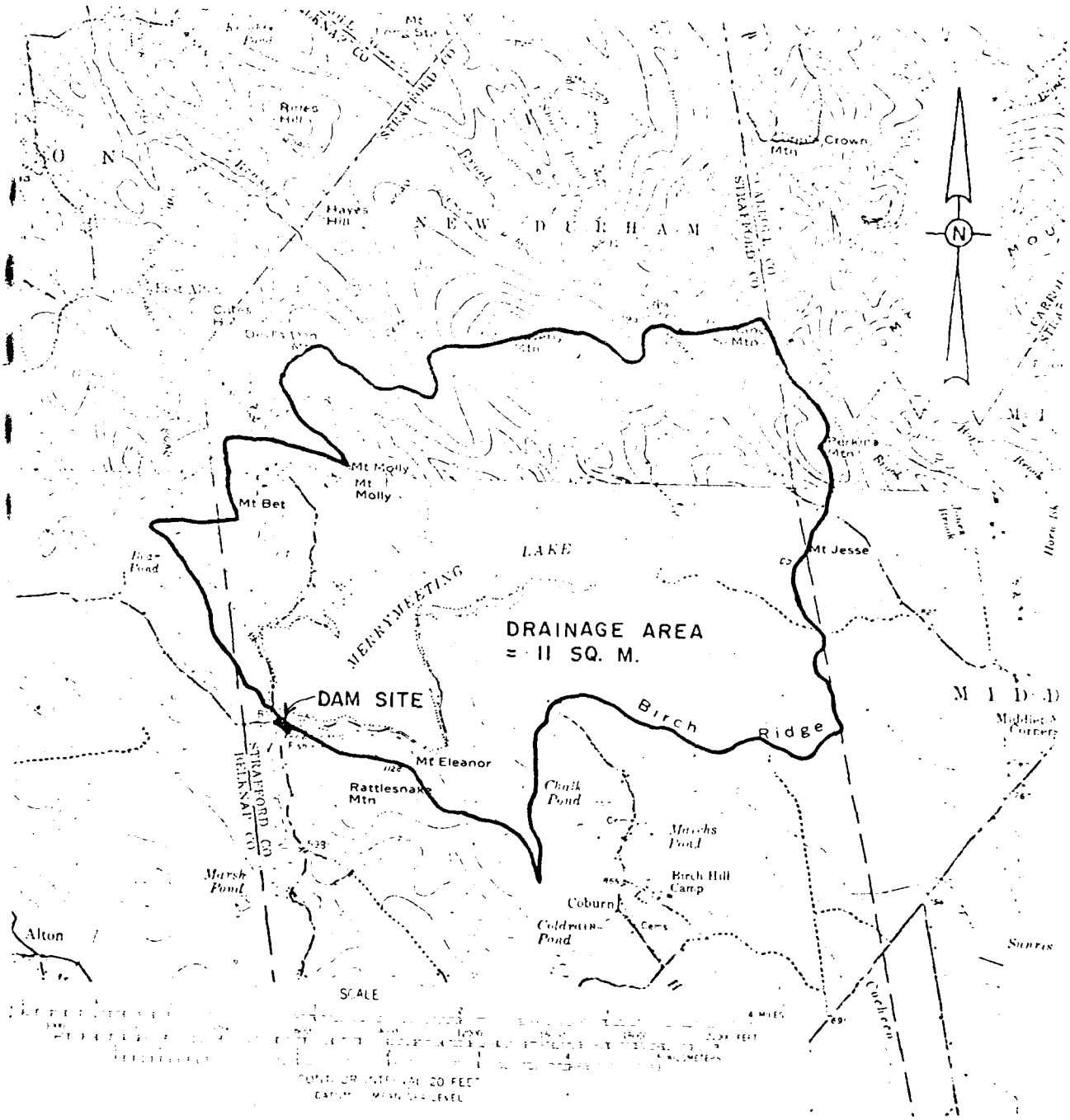
= 15.15 hours Say 15



MERRYMEETING LAKE DAM
SPILLWAY AND OVERTOP
RATING CURVE



MERRYMEETING LAKE DAM
RESERVOIR CAPACITY CURVE



MERRYMEETING LAKE DAM
DRAINAGE BASIN

CI-4 ENGINEERING CONSULTANTS, INC.

NEW HAMPSHIRE DAM SAFETY INSPECTION SHEET NO. 1 OF
MERRYMEETING LAKE DAM JOB NO. 1211-001-1
DAM FAILURE STUDY BY KLB DATE 8-4-11

MERRYMEETING LAKE DAM

EFFECTS OF DAM FAILURE

STEP 1: DETERMINE PEAK FAILURE OUTFLOW Q_{P_1}

$$Q_{P_1} = \frac{8}{27} W_b \sqrt{2g} Y_o^{3/2}$$

W_b = 0.40 X DAM LENGTH ACROSS RIVER AT MID HEIGHT AT PMF

= 0.40 X DAM LENGTH AT EL 651.5

= 0.40 X 286±

= 114.4 FT

Y_o = TOTAL HEIGHT FROM RIVER BED TO TOP OF DAM

= 650.5 − 628.5 = 22 FT.

$$Q_{P_1} = \frac{8}{27} (114.4) \sqrt{64.4} (22)^{1.5}$$

Q_{P_1} = 28069 CFS

ECI-4 ENGINEERING CONSULTANTS, INC.

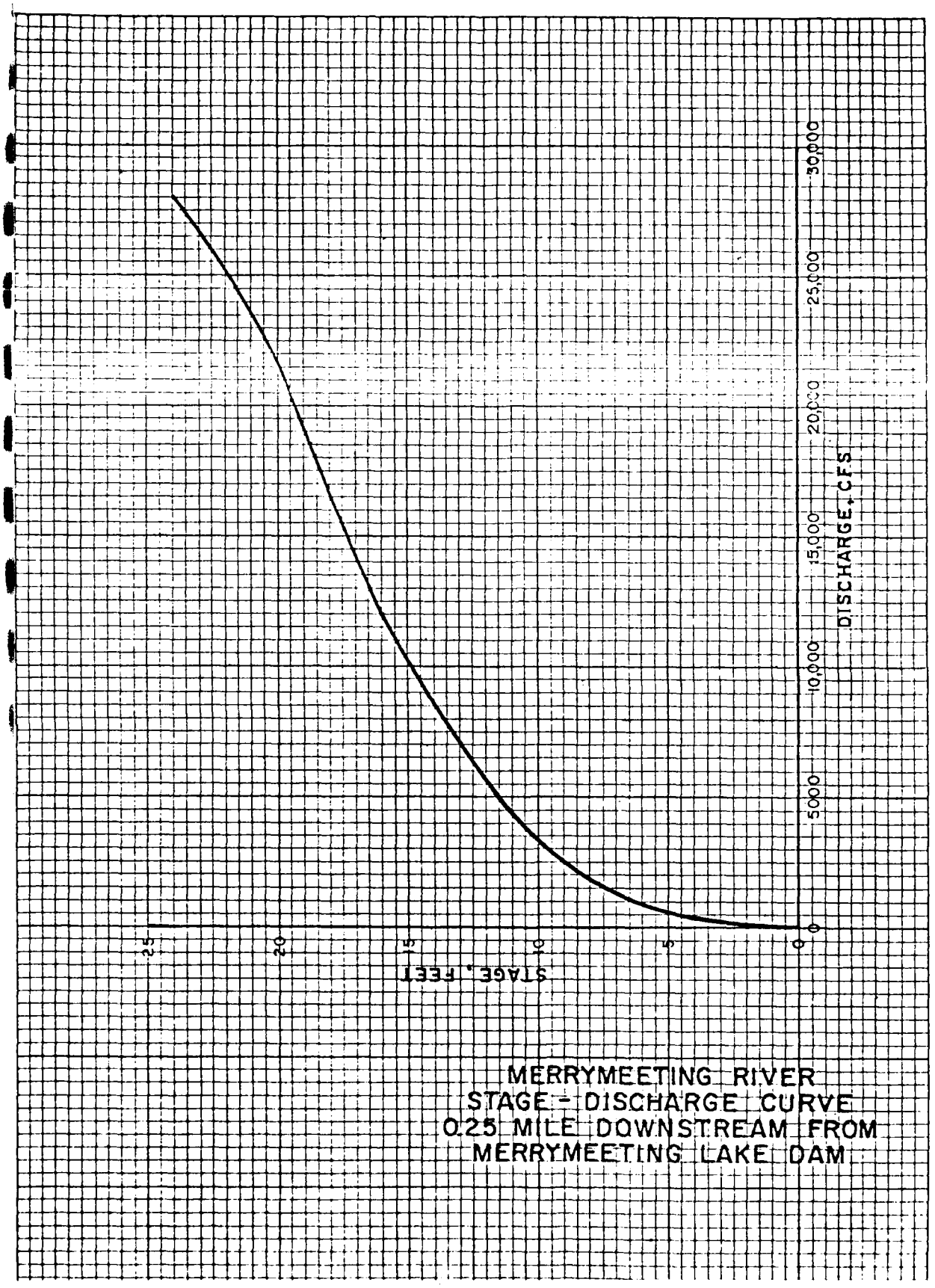
NEW HAMPSHIRE DAM SAFETY INSPECTION SHEET NO. 2 OF
MERRYMEETING LAKE DAM JOB NO. 1211-001-1
DAM FAILURE STUDY BY KLB DATE 8-4-77

STEP 2: DEVELOP STAGE DISCHARGE RATING CURVES FOR THE DOWNSTREAM CHANNEL (ASSUMPTIONS AND PROCEDURES ARE THE SAME AS FOR STINSON LAKE DAM) THE STAGE DISCHARGE CURVES ARE ON PAGES 3 THROUGH 6

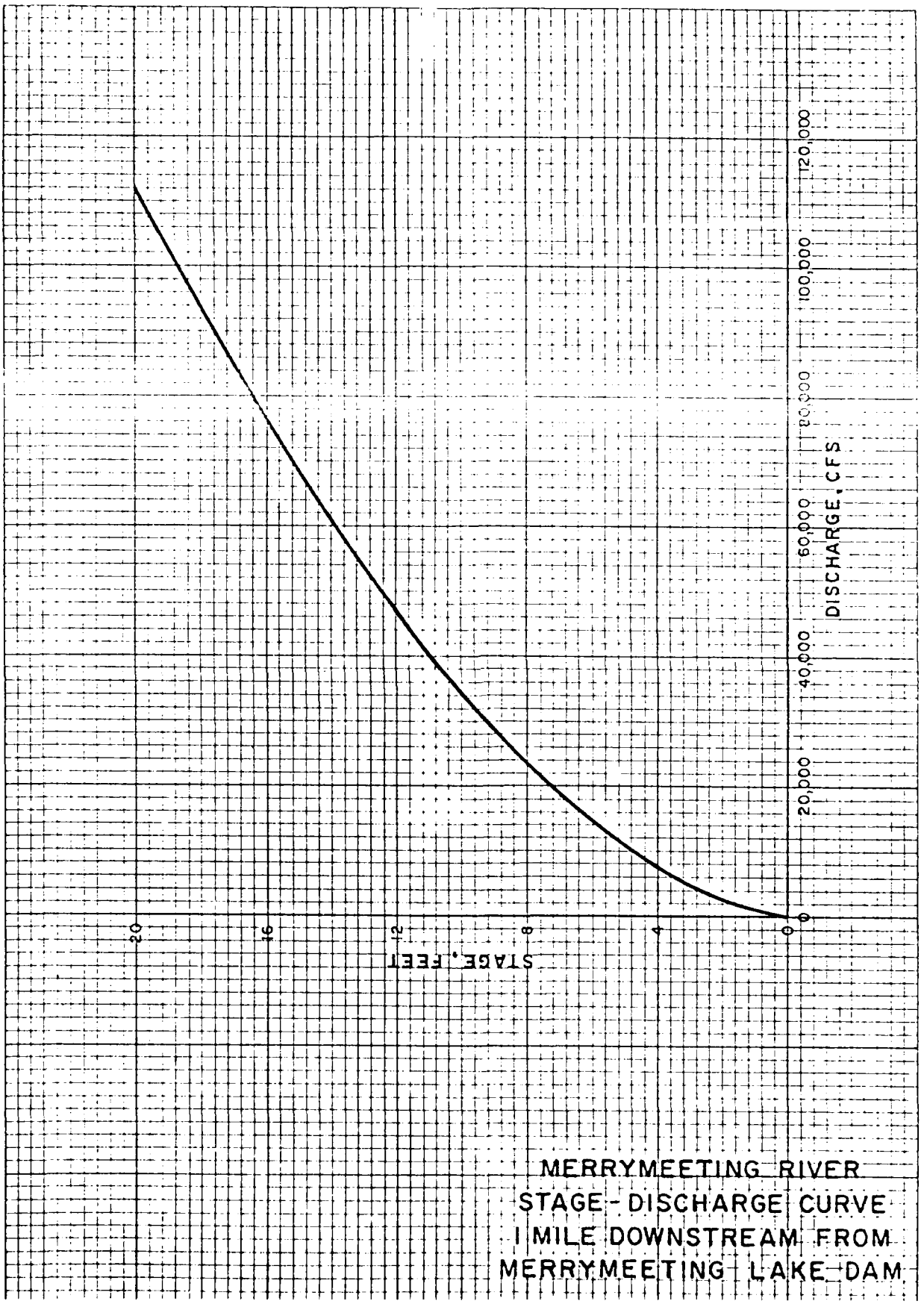
STEP 3: DETERMINE STAGE CORRESPONDING TO Q_{p_1} AT EACH SECTION (ASSUMPTIONS ARE THE SAME AS FOR STINSON LAKE DAM)

PEAK DISCHARGE Q_{p_1} = 280.69 CFS

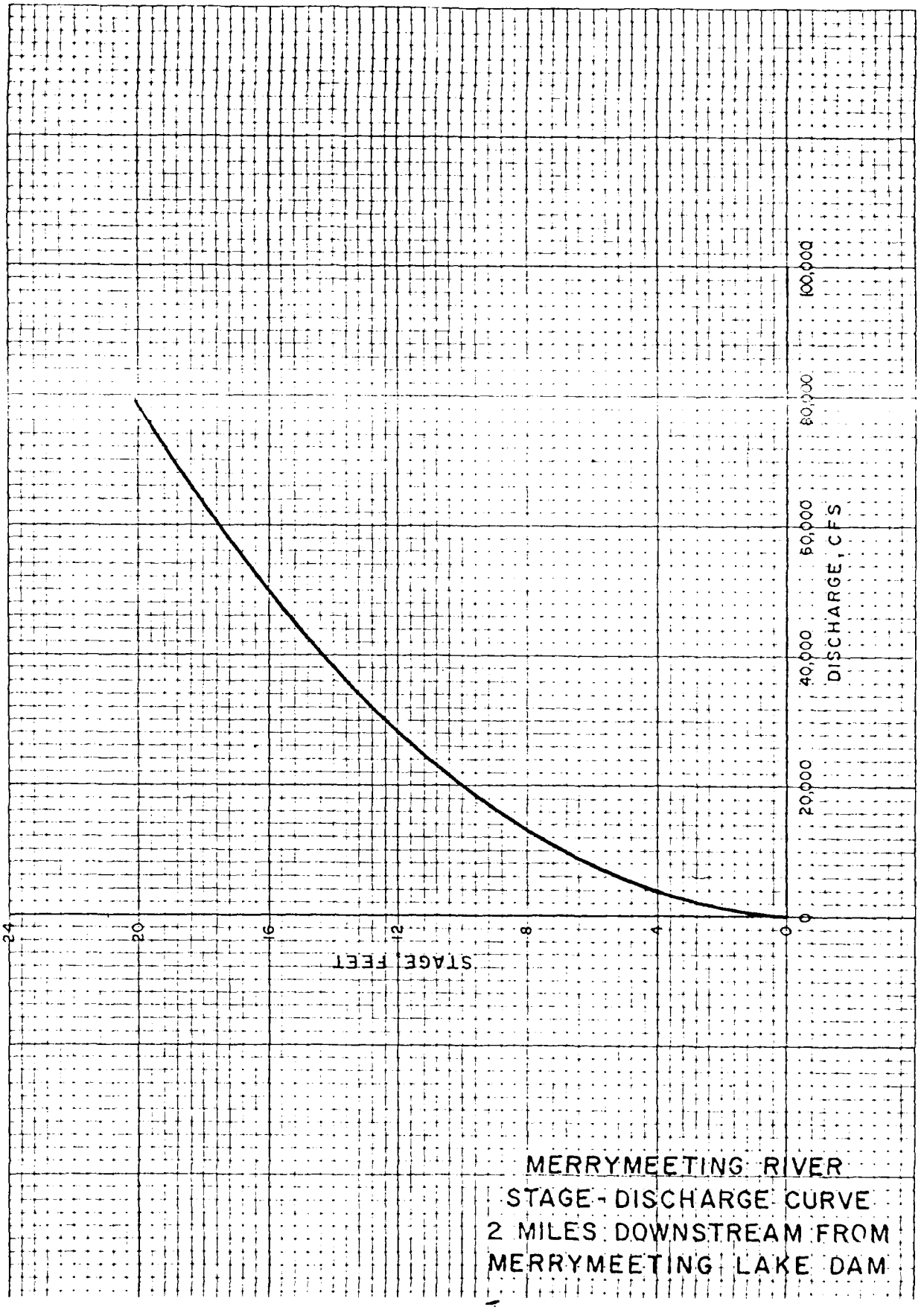
DISTANCE DOWNSTREAM FROM DAM, MILES	0.25	1	2	3
STAGE, FEET	24.1	8.9	12.0	17.3



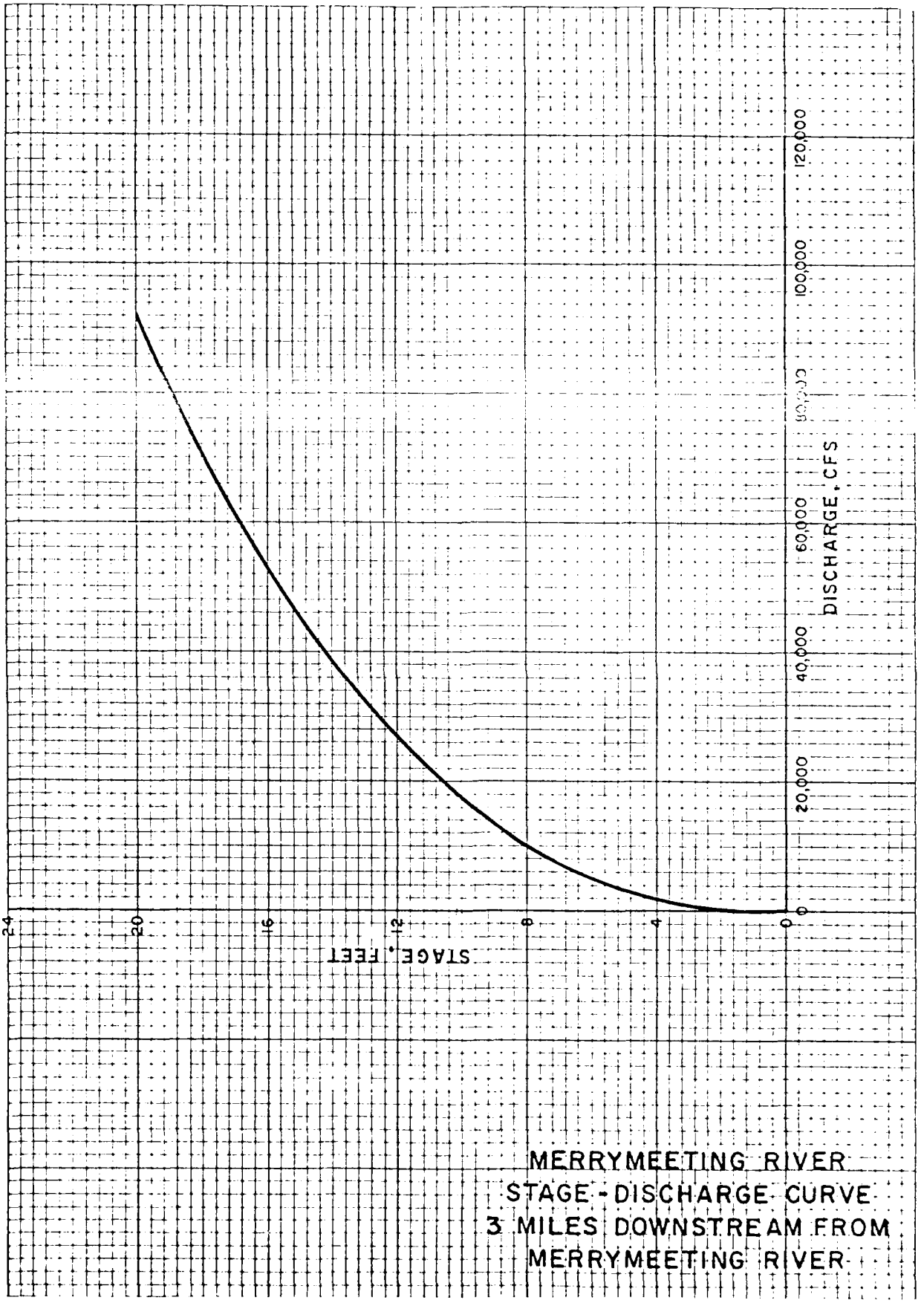
MERRYMEETING RIVER
STAGE - DISCHARGE CURVE
0.25 MILE DOWNSTREAM FROM
MERRYMEETING LAKE DAM



MERRYMEETING RIVER
STAGE - DISCHARGE CURVE
1 MILE DOWNSTREAM FROM
MERRYMEETING LAKE DAM



MERRYMEETING RIVER
STAGE - DISCHARGE CURVE
2 MILES DOWNSTREAM FROM
MERRYMEETING LAKE DAM



MERRYMEETING RIVER
STAGE - DISCHARGE CURVE
3 MILES DOWNSTREAM FROM
MERRYMEETING RIVER

ECI-4 ENGINEERING CONSULTANTS, INC.

SHEET NO. 2 OF

JOB NO.

BY DATE 7-15-70

Stage-discharge data
[illegible]

Stage ft	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
0	0	0	0	0	0
4	134	69	2	276	276
8	944	136	4	1377	1836
12	[illegible]	204	6	[illegible]	5570
16	2176	272	8	9765	12018
20	[illegible]	340	10	[illegible]	21787
24	[illegible]	271	[illegible]	[illegible]	[illegible]
28	[illegible]	[illegible]	8	[illegible]	[illegible]

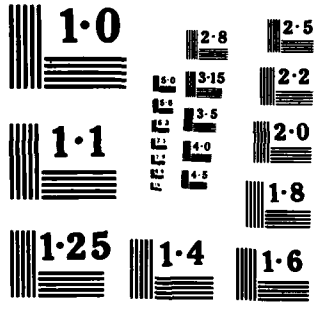
Channel slope, $S = \frac{22}{2600} = 0.0085$ ft/ft.

Assumed $n = 0.10$

AD-A156 448 NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS MERRYMEETING LAKE DAM..(U) CORPS OF ENGINEERS WALTHAM MA NEW ENGLAND DIV OCT 78 2/2

UNCLASSIFIED F/G 13/13 NL

END
DATE FILMED
8 85
DTIC


1·0
1·1
1·25
2·8
3·15
3·5
4·0
4·5
1·4
2·5
2·2
2·0
1·8
1·6

ECI-4 ENGINEERING CONSULTANTS, INC.

New Hampshire Dam Safety Inspection — SHEET NO. ____ OF ____

Meetinghouse Lake Dam — JOB NO. 1211-01

~~Dam Failure Hydrograph~~ Downstream channel Rating curve — BY M.R.H. DATE 6/28/78

Stage H	Area A sq.ft.	Wetted Perimeter WP ft.	Hydraulic Radius R ft.	$AR^{2/3}$	$Q = \frac{1.49}{n} AR^{2/3}$ $Q = 0.618\, AR^{2/3}$ cu.ft./sec.
0	0	0	0	0	0
4	4820	1230	3.92	11990	7410
8	9820	1275	7.70	38300	23670
12	15030	1325	11.34	75890	46900
16	20440	1375	14.87	123590	76370
20	26100	1430	18.25	180,930	111800

Channel slope, $S = 20/(0.2 \times 5280) = 0.00172$ ft./ft.

$n = 0.10$

Stage - Discharge for 1 mile downstream

ECI-4 ENGINEERING CONSULTANTS, INC.

New Hampshire Dam Safety Inspection
Merrymeeting Lake Dam
~~Dam Failure Hydrograph~~ Downstream channel rating curve

SHEET NO. ____ OF ____
JOB NO. 1211-01
BY M.R.H. DATE 6/28/12

Stage Ft.	Area A sq. ft.	Wetted Perimeter P Ft.	Hydraulic Radius R Ft.	$AR^{2/3}$	$Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$ $Q = 0.618\, AR^{2/3}$ cu ft/sec
0	0	0	0	0	0
4	2590	770	3.36	5815	3590
8	6260	1040	6.02	20715	12800
12	10620	1140	9.32	47050	29080
16	15360	1235	12.44	82460	50960
20	20420	1320	15.47	126790	78350

Channel Slope, $S = 20/(2.2 \times 5280) = 0.00172$ ft./ft.

$n = 0.10$

Stage - Discharge for 2 miles downstream.

ECI-4 ENGINEERING CONSULTANTS, INC.

New Hampshire Dam Safety Inspection — SHEET NO. ____ OF ____

Merrymeeting Lake Dam — JOB NO. 1211-01

~~Dam Failure Hydrograph~~ Downstream channel rating curve — BY M.R.H. DATE 4/28/78

Stage H.	Area A sq ft	Wetted Perimeter wp ft	Hydraulic Radius R ft	$AR^{2/3}$	$Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$ $Q = 1.75\, AR^{2/3}$ cu ft/sec
0	0	0	0	0	0
4	640	320	2	1016	1780
8	2240	560	4	5645	9880
12	4560	760	6	15060	26360
16	7800	975	8	31200	54620
20	11300	1130	10	52450	91810

Channel Slope, S = 40/(.55 x 5280) = 0.0138 ft./ft.

n = 0.10

Stage - Discharge for 3 miles downstream

HEC 1 - COMPUTATIONS

HEC-1 VERSION DATED JAN 1973

DAM SAFETY INSPECTION - NEW HAMPSHIRE
MERRYMEETING LAKE DAM
PERCENT OF PMF FLOOD

JOB SPECIFICATION

NU	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	0	30	0	0	0	0	0	4	0

JUPER NWT
5 0

SUB-AREA RUNOFF COMPUTATION

INPUT DRIVED TRIANGULAR SHAPED HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	0	0	0	0	0	1

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LSTR
-1	0	11.00	0.00	11.00	0.00	0.205	0	0	0

HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THRU MERRYMEETING LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	1	0	0	0	0	1

ROUTING DATA

	GLOSS	CLOSS	AVG	IRES	ISAME
	0.0	0.000	0.00	1	0

	NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
	0	0	0	0.000	0.000	0.000	-1.

STORAGE=	19000.	21800.	22550.	23850.	24850.	26890.	31430.	0.	0.	0.
OUTFLOW=	0.	50.	500.	1750.	6800.	13700.	21500.	0.	0.	0.

RUNOFF SUMMARY: AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	3649.	2919.	1140.	360.	11.00
ROUTED TO	1	190.	161.	146.	67.	11.00

```
****************************
HEC-1 VERSION DATED JAN 1973

****************************
                           DAM SAFETY INSPECTION - NEW HAMPSHIRE
                              MERRYMEETING LAKE DAM
                                   PMP FLOOD

                                JOB SPECIFICATION
           NQ    NHR   NMIN   IDAY    IHR   IMIN METRC   IPLT   IPRT NSTAN
          150      0     30      0      0      0     0      0      0     0
                                JOPER     NWT
                                    5       0



     **********       **********       **********       **********       **********

                              SUB-AREA RUNOFF COMPUTATION

                        INPUT DRIVED TRIANGULAR SHAPED HYDROGRAPH

                    ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                        1       0       0       0       0       0       1

                                      HYDROGRAPH DATA
          IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
             -1       0   11.00    0.00   11.00    0.00   0.000       0       0       0

                                      INPUT HYDROGRAPH
        0.     1187.     2373.     3560.     4747.     5933.     7120.     8307.     9493.    10680.
    11867.    13053.    14240.    15427.    16613.    17800.    16613.    15427.    14240.    13053.
    11867.    10680.     9493.     8307.     7120.     5933.     4747.     3560.     2373.     1187.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
        0.        0.        0.        0.        0.        0.        0.        0.        0.        0.

                          PEAK    6-HOUR    24-HOUR    72-HOUR   TOTAL VOLUME
                 CFS     17800.    14240.     5562.      1854.       267000.
              INCHES               12.04      18.81      18.81         18.81
               AC-FT                7064.     11038.     11038.        11038.



     **********       **********       **********       **********       **********

                                 HYDROGRAPH ROUTING
```

ROUTE HYDROGRAPH THRU MERRYMEETING LAKE DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
1	1	0	0	2	0	1

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.000	0.00	1	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA
0	0	0	0.000	0.000	0.000	-1.

STORAGE=	19500.	21300.	22550.	23850.	26350.	28890.	31430.	0.	0.	0.
OUTFLOW=	0.	50.	500.	1750.	6800.	13700.	21500.	0.	0.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	19500.	0.	0.
2	19524.	593.	0.
3	19597.	1780.	2.
4	19720.	2966.	6.
5	19891.	4153.	10.
6	20111.	5340.	16.
7	20380.	6526.	24.
8	20698.	7713.	33.
9	21064.	8900.	43.
10	21477.	10086.	114.
11	21935.	11273.	278.
12	22435.	12460.	458.
13	22970.	13646.	904.
14	23535.	14833.	1447.
15	24119.	16020.	2295.
16	24711.	17206.	3490.
17	25295.	17206.	4589.
18	25708.	16020.	5505.
19	26078.	14833.	6252.
20	26371.	13646.	6859.
21	26591.	12460.	7454.
22	26740.	11273.	7860.
23	26827.	10086.	8097.
24	26858.	8900.	8182.
25	26840.	7713.	8132.
26	26777.	6526.	7962.
27	26675.	5340.	7683.
28	26537.	4153.	7308.
29	26367.	2966.	6846.
30	26166.	1780.	6429.
31	25934.	593.	5961.
32	25698.	0.	5483.
33	25480.	0.	5044.
34	25280.	0.	4640.
35	25096.	0.	4268.
36	24927.	0.	3926.
37	24771.	0.	3611.
38	24628.	0.	3322.
39	24496.	0.	3056.
40	24375.	0.	2811.
41	24263.	0.	2586.
42	24161.	0.	2378.
43	24066.	0.	2188.
44	23980.	0.	2012.
45	23900.	0.	1851.
46	23826.	0.	1727.

47	23756.	0.	1659.
48	23689.	0.	1595.
49	23624.	0.	1533.
50	23562.	0.	1473.
51	23502.	0.	1415.
52	23445.	0.	1360.
53	23390.	0.	1307.
54	23337.	0.	1256.
55	23286.	0.	1207.
56	23237.	0.	1160.
57	23190.	0.	1115.
58	23145.	0.	1072.
59	23101.	0.	1030.
60	23059.	0.	990.
61	23019.	0.	951.
62	22981.	0.	914.
63	22944.	0.	878.
64	22908.	0.	844.
65	22874.	0.	811.
66	22841.	0.	780.
67	22809.	0.	749.
68	22779.	0.	720.
69	22750.	0.	692.
70	22722.	0.	665.
71	22695.	0.	639.
72	22669.	0.	614.
73	22644.	0.	590.
74	22620.	0.	567.
75	22597.	0.	545.
76	22575.	0.	524.
77	22554.	0.	503.
78	22533.	0.	494.
79	22513.	0.	486.
80	22493.	0.	479.
81	22473.	0.	472.
82	22454.	0.	465.
83	22435.	0.	458.
84	22416.	0.	451.
85	22397.	0.	445.
86	22379.	0.	438.
87	22361.	0.	432.
88	22343.	0.	425.
89	22326.	0.	419.
90	22309.	0.	413.
91	22292.	0.	407.
92	22275.	0.	401.
93	22258.	0.	395.
94	22242.	0.	389.
95	22226.	0.	383.
96	22210.	0.	377.
97	22195.	0.	372.
98	22180.	0.	366.
99	22165.	0.	361.
100	22150.	0.	356.
101	22135.	0.	350.
102	22121.	0.	345.
103	22107.	0.	340.
104	22093.	0.	335.
105	22079.	0.	330.
106	22065.	0.	325.
107	22052.	0.	320.

108	22039.	0.	316.	
109	22026.	0.	311.	
110	22013.	0.	306.	
111	22000.	0.	302.	
112	21988.	0.	297.	
113	21976.	0.	293.	
114	21964.	0.	289.	
115	21952.	0.	284.	
116	21940.	0.	280.	
117	21929.	0.	276.	
118	21917.	0.	272.	
119	21906.	0.	268.	
120	21895.	0.	264.	
121	21884.	0.	260.	
122	21874.	0.	256.	
123	21863.	0.	252.	
124	21853.	0.	249.	
125	21843.	0.	245.	
126	21832.	0.	241.	
127	21823.	0.	238.	
128	21813.	0.	234.	
129	21803.	0.	231.	
130	21794.	0.	227.	
131	21784.	0.	224.	
132	21775.	0.	221.	
133	21766.	0.	217.	
134	21757.	0.	214.	
135	21748.	0.	211.	
136	21740.	0.	208.	
137	21731.	0.	205.	
138	21723.	0.	202.	
139	21714.	0.	199.	
140	21706.	0.	196.	
141	21698.	0.	193.	
142	21690.	0.	190.	
143	21682.	0.	187.	
144	21675.	0.	185.	
145	21667.	0.	182.	
146	21660.	0.	179.	
147	21652.	0.	176.	
148	21645.	0.	174.	
149	21638.	0.	171.	
150	21631.	0.	169.	
SUM			215498.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	8182.	7422.	3798.	1496.	215498.
INCHES		6.27	12.71	15.18	15.18
AC-FT		3682.	7558.	8907.	8909.

RUNOFF SUMMARY: AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	17800.	14240.	5562.	1854.	11.00
ROUTED TO	1	8182.	7422.	3758.	1496.	11.00

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*****************************
HEC-1 VERSION DATED JAN 1973

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                                   DAM SAFETY INSPECTION - NEW HAMPSHIRE
                                        MERRYMEETING LAKE DAM
                                        ONE HALF PMP FLOOD

                                          JOB SPECIFICATION
                          NQ    NHR   NMIN  IDAY    IHR  IMIN METRC   IPLT   IPRT NSTAN
                         150      0     30     0      0     0     0      0      0     0
                                             JOPER      NWT
                                                 3        0



                **********          **********          **********          **********          **********

                                     SUB-AREA RUNOFF COMPUTATION

                                INPUT DRIVED TRIANGULAR SHAPED HYDROGRAPH

                            ISTAQ    ICOMP    IECON    ITAPE     JPLT     JPRT    INAME
                                1        0        0        0        0        0        1

                                                   HYDROGRAPH DATA
                     IHYDG     IUHG    TAREA     SNAP    TRSDA    TRSPC    RATIO    ISNOW    ISAME    LOCAL
                        -1        0    11.00     0.00    11.00     0.00    0.500        0        0        0

                                                   INPUT HYDROGRAPH
               0.     1187.     2373.     3560.     4747.     5933.     7120.     8307.     9493.    10680.
           11867.    13053.    14240.    15427.    16613.    17800.    16613.    15427.    14240.    13053.
           11867.    10680.     9493.     8307.     7120.     5933.     4747.     3560.     2373.     1187.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.

                                  PEAK    6-HOUR    24-HOUR    72-HOUR   TOTAL VOLUME
                         CFS     17800.    14240.      5562.      1854.        267000.
                      INCHES                12.04      18.81      18.81          18.81
                       AC-FT                7064.     11038.     11038.         11038.

                                               RUNOFF MULTIPLIED BY 0.50
               0.      593.     1186.     1780.     2373.     2966.     3560.     4153.     4746.     5340.
            5933.     6526.     7120.     7713.     8306.     8900.     8306.     7713.     7120.     6526.
            5933.     5340.     4746.     4153.     3560.     2966.     2373.     1780.     1186.      593.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
               0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
```

6

```
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.
     0.        0.        0.        0.        0.        0.        0.        0.        0.        0.

                               PEAK    6-HOUR   24-HOUR   72-HOUR   TOTAL VOLUME
                     CFS       8900.    7120.     2781.      927.       133500.
                  INCHES                 6.02      9.40      9.40          9.40
                   AC-FT                3532.     5519.     5519.         5519.


  **********          **********          **********          **********          **********

                                  HYDROGRAPH ROUTING

                        ROUTE HYDROGRAPH THRU MERRYMEETING LAKE DAM

                     ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME
                         1       1       0       0       0       0       1
                                       ROUTING DATA
                             QLOSS   CLOSS     AVG    IRES   ISAME
                               0.0   0.000    0.00       1       0

                     NSTPS   NSTOL     LAG   AMSKK       X     TSK   STORA
                         0       0       0   0.000   0.000   0.000     -1.

STORAGE=     19500.     21300.     22550.     23850.     26350.     28890.     31430.        0.        0.        0.
OUTFLOW=         0.        50.       500.      1750.      6800.     13700.     21500.        0.        0.        0.

                              TIME  EOP STOR    AVG IN   EOP OUT
                                 1    19500.        0.        0.
                                 2    19512.      296.        0.
                                 3    19548.      890.        1.
                                 4    19610.     1483.        3.
                                 5    19695.     2076.        5.
                                 6    19805.     2670.        8.
                                 7    19940.     3263.       12.
                                 8    20099.     3856.       16.
                                 9    20282.     4450.       21.
                                10    20489.     5043.       27.
                                11    20721.     5636.       33.
                                12    20977.     6230.       41.
                                13    21257.     6823.       48.
                                14    21559.     7416.      143.
                                15    21882.     8010.      259.
                                16    22224.     8603.      382.
                                17    22561.     8603.      511.
                                18    22865.     8010.      803.
                                19    23153.     7416.     1060.
                                20    23366.     6823.     1285.
                                21    23567.     6230.     1478.
                                22    23735.     5636.     1640.
                                23    23873.     5043.     1796.
                                24    23978.     4450.     2009.
```

25	24051.	3856.	2157.
26	24095.	3263.	2245.
27	24112.	2670.	2279.
28	24104.	2076.	2263.
29	24073.	1483.	2201.
30	24021.	890.	2095.
31	23949.	296.	1951.
32	23872.	0.	1795.
33	23800.	0.	1702.
34	23751.	0.	1635.
35	23664.	0.	1572.
36	23601.	0.	1510.
37	23540.	0.	1451.
38	23481.	0.	1395.
39	23424.	0.	1341.
40	23370.	0.	1288.
41	23318.	0.	1238.
42	23267.	0.	1190.
43	23219.	0.	1143.
44	23173.	0.	1099.
45	23128.	0.	1056.
46	23085.	0.	1015.
47	23044.	0.	975.
48	23005.	0.	937.
49	22967.	0.	901.
50	22930.	0.	866.
51	22895.	0.	832.
52	22861.	0.	799.
53	22829.	0.	768.
54	22798.	0.	738.
55	22768.	0.	710.
56	22739.	0.	682.
57	22712.	0.	655.
58	22685.	0.	630.
59	22659.	0.	605.
60	22635.	0.	582.
61	22611.	0.	559.
62	22589.	0.	537.
63	22567.	0.	516.
64	22546.	0.	498.
65	22525.	0.	491.
66	22505.	0.	484.
67	22485.	0.	476.
68	22466.	0.	469.
69	22447.	0.	462.
70	22428.	0.	456.
71	22409.	0.	449.
72	22390.	0.	442.
73	22372.	0.	436.
74	22354.	0.	429.
75	22337.	0.	423.
76	22319.	0.	417.
77	22302.	0.	410.
78	22285.	0.	404.
79	22269.	0.	398.
80	22252.	0.	393.
81	22236.	0.	387.
82	22220.	0.	381.
83	22205.	0.	375.
84	22189.	0.	370.
85	22174.	0.	364.

86	22159.	0.	359.
87	22144.	0.	354.
88	22130.	0.	348.
89	22116.	0.	343.
90	22101.	0.	338.
91	22088.	0.	333.
92	22074.	0.	328.
93	22060.	0.	323.
94	22047.	0.	319.
95	22034.	0.	314.
96	22021.	0.	309.
97	22008.	0.	305.
98	21996.	0.	300.
99	21984.	0.	296.
100	21971.	0.	291.
101	21959.	0.	287.
102	21948.	0.	283.
103	21936.	0.	279.
104	21925.	0.	275.
105	21913.	0.	270.
106	21902.	0.	266.
107	21891.	0.	263.
108	21880.	0.	259.
109	21870.	0.	255.
110	21859.	0.	251.
111	21849.	0.	247.
112	21839.	0.	244.
113	21829.	0.	240.
114	21819.	0.	236.
115	21809.	0.	233.
116	21800.	0.	230.
117	21790.	0.	226.
118	21781.	0.	223.
119	21772.	0.	219.
120	21763.	0.	216.
121	21754.	0.	213.
122	21745.	0.	210.
123	21736.	0.	207.
124	21728.	0.	204.
125	21720.	0.	201.
126	21711.	0.	198.
127	21703.	0.	195.
128	21695.	0.	192.
129	21687.	0.	189.
130	21679.	0.	186.
131	21672.	0.	184.
132	21664.	0.	181.
133	21657.	0.	178.
134	21649.	0.	175.
135	21642.	0.	173.
136	21635.	0.	170.
137	21628.	0.	168.
138	21621.	0.	165.
139	21614.	0.	163.
140	21608.	0.	160.
141	21601.	0.	158.
142	21595.	0.	156.
143	21588.	0.	153.
144	21582.	0.	151.
145	21576.	0.	149.
146	21570.	0.	147.

147	21563.	0.	145.	
148	21558.	0.	142.	
149	21552.	0.	140.	
150	21546.	0.	138.	
SUM			84037.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2279.	2011.	1229.	583.	84037.
INCHES		1.70	4.15	5.92	5.92
AC-FT		997.	2439.	3473.	5474.

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RUNOFF SUMMARY: AVERAGE FLOW

		PEAK	3-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	8900.	7120.	2781.	927.	11.00
ROUTED TO	1	2279.	2011.	1229.	583.	11.00

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

INVENTORY OF DAMS IN THE UNITED STATES

STATE	IDENTITY NUMBER	DIVISION	STATE	COUNTY	CONGR DIST.	STATE	COUNTY	CONGR DIST.	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE DAY | MO | YR
NH	382	NED	NH	017	01				MERRYMEETING LAKE DAM	4328.6	7110.8	150CT78

POPULAR NAME	NAME OF IMPOUNDMENT
	MERRYMEETING LAKE

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY–TOWN–VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	05	MERRYMEETING RIVER	NEW DURHAM	5	535

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUC. HEIGHT (FT.)	HYDRAU. HEIGHT (FT.)	IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.)	IMPOUNDING CAPACITIES NORMAL (ACRE-FT.)	DIST	UNN	FED R	PRV/FED	SCS A	VER/DATE
REGHCTPG	1925	RS	22	22	21960	19500	NED	N	N	N	N	21SEP78

REMARKS

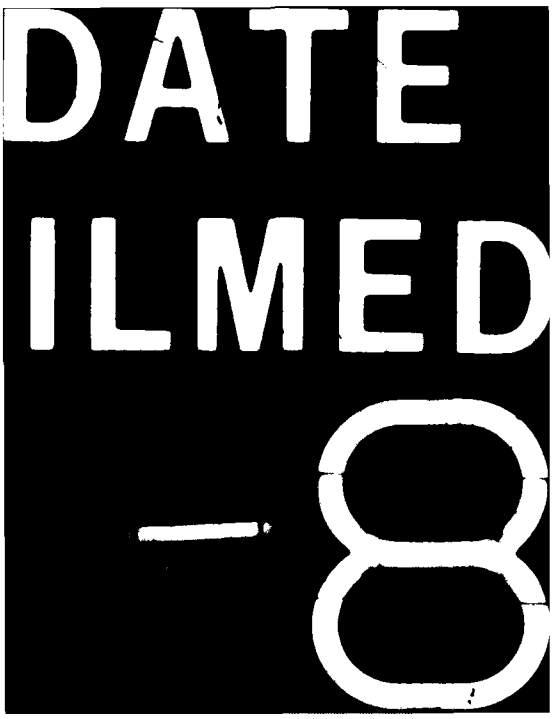
D/S HAS	SPILLWAY CREST LENGTH	SPILLWAY TYPE	SPILLWAY WIDTH (FT.)	MAXIMUM DISCHARGE (FT.)	VOLUME OF DAM (CY)	POWER CAPACITY INSTALLED (MW)	POWER CAPACITY PROPOSED (MW)	NAVIGATION LOCKS NO.	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)	LENGTH (FT.)	WIDTH (FT.)
1	286	C	20	190												

OWNER	ENGINEERING BY	CONSTRUCTION BY
NH FISH AND GAME DEPT	I M JONES CO	AMES CONSTRUCTION CO

REGULATORY AGENCY			
DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

INSPECTION BY	INSPECTION DATE DAY | MO | YR	AUTHORITY FOR INSPECTION
HARRIS-ECI ASSOCIATES	06JUN78	PL 92-367

REMARKS


DATE
ILMED
-8